E.1

10/13/95

0000008

October 13, 1995

Ms. Verneta Simon
On-Scene Coordinator
U.S. Environmental Protection Agency
77 W. Jackson Blvd., HSE-5J
Chicago, IL 60604

RE: Report for Characterization Investigation Gamma Radiation Survey, Lindsay Light II Site, 316 E. Illinois Street, Chicago, Illinois -- STS Project No. 27313-ZH

Dear Ms. Simon:

Attached please find the above-referenced report. We have included only those sections which were revised from the previous report. The instructions below describe which sections to discard and where to insert the attached material.

Volume I

- Please remove and discard the entire text section from the Title Page through Section 5.0 References. Replace with the attached text section which now extends through Section 6.0 References.

- Insert Table 5a in the Tables section after Table 5.

Volume II

No Change

Volume III

- The first data pages, double sided, pages 0000001 and 0000002 of the "Isotopic Uranium" section (approximately 65 pages from the front) should be discarded and replaced with 0000001 and 0000002 Isotopic Uranium Analysis data table pages.

- At the end of the "Isotopic Uranium" section, 66 pages farther back, insert the new section "Uranium Isotopes by Alpha Spectroscopy". No discard is associated with this insert. The insert is immediately in front of the "Chain of Custodies" header page.

STS Consultants Ltd.
Consulting Engineers

1415 Lake Cook Road
Deerfield, Illinois 60015
708.272.6520/Fax 708.498.2721

- Approximately 60% back is the section "Isotopic Thorium". The first two data pages 0000001 and 0000002 should be discarded and replaced with the new 0000001 and 0000002 Isotopic Thorium Analysis data table pages.

- At approximately 80 percent back is the "Gamma Spectroscopy" section. Remove and discard pages 0000001 through 0000004 and replace with the attached Case Narrative and data sheet pages 0000001 through 0000004.

Please contact us with any questions you may have regarding this matters.

Regards,

STS CONSULTANTS, LTD.

Richard G. Berggreen
Principal Geologist

cc: J. D. White, Kerr-McGee
Charles Gardner, Chicago Dock & Canal Trust
Vincent Oleskiewicz, Baker & McKenzie

chcproj.27313-ZH.revsec.wp5.jm

October 13, 1995

Ms. Verneta Simon
U.S. Environmental Protection Agency
77 West Jackson Blvd.
HSE3-5J
Chicago, IL 60604-3590

RE: Response to USEPA Review Comments Letter Dated August 18, 1995, Lindsay Light II Site, 316 E. Illinois Street, Chicago, Illinois -- STS Project No. 27313-ZH

Dear Ms. Simon:

This letter and the attached revisions are in response to your letter dated August 18, 1995. With these revisions and responses, we anticipate the submittal will be acceptable to USEPA and can be approved. We have included an affidavit in accordance with Section 24 of the Administration Order by Consent dated January 27, 1994 (AOC). There being no payments due under the terms of Section 25 of the AOC, the Respondent (The Chicago Dock and Canal Trust) requests written notice from USEPA per Section 25 of the AOC that the Respondent has demonstrated, to the satisfaction of USEPA, that all of the terms of the AOC, including any additional tasks consistent with the AOC which USEPA has determined to be necessary, have been completed.

In addition, we wish to clarify the usage of a term in the referenced report. Throughout the report, we refer to the monazite sand, building debris contaminated with monazite sand, thorium nitrate derived from the sand, or finished or discarded gas mantle parts as the source for the gamma radiation detected. The use of the term "source" is intended to refer to a source of radiation, and not "source" as opposed to "by-product 11(e)2" classification material determination by IDNS. This clarification, in our opinion, does not require any revision to the subject document.

We appreciate your prompt response to these submittals and welcome any questions you have regarding this matter. The following responses are numbered to refer to your comment numbers.

"Letter Attached to Report"

1. **Executive Summary Comments**
   - Item 6 - The scenario deserves a separate section. It should not be presented solely in the Conclusions section.

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A separate section, 4.0 Elementary Radiological Risk Assessment, has been provided to present the risk assessment scenario previously included only in the Conclusions section. The Conclusions section is now Section 5.0.

- Item 8 - At the end of paragraph 1 it is stated that "This <u>will be</u> corrected" and at the beginning of paragraph 3 it is stated that "We <u>propose</u>...." If this has been done it should be stated as having been completed. Has it been done?

The comments should have indicated these revisions have been made. Both changes were made in the Report dated July 26, 1995.

2. **General Comments**
- Item 2, paragraph 1 at top of page 3 - A MDA of 20 pCi/g for the Th-230 is quite high. Please explain.

The quality control documentation for the laboratory specifies the MDA. The laboratory report indicates the MDA for Th-230 by gamma spectroscopy is 20 pCi/gm. This MDA is judged appropriate for this nuclide, in this matrix and by this method.

3. **Specific Comments**
- Item 9, last paragraph - The K-40 concentrations seem substantially above background. Explain why these levels are not deemed to be indicative of contamination or of other contaminants.

The material submitted for chemical and radiological analysis is classified as fill. Urban fill soil consists of a heterogeneous mixture of soil, building rubble (brick, stone, mortar, metal, glass, wood), cinders and ash from fires and furnaces, paving stones, curbs, asphalt, cement and foundation debris, etc. As such, it will be expected to have a wide range of chemistry and lithology.

In reviewing the National Council on Radiation Protection (NCRP) Report No. 94, December 30, 1987, Table 4.3 presents a summary of concentrations of major radionuclides in rock and soil. Recognizing the percentage of potassium and, therefore, the concentration of potassium-40 will vary with the mineralogy of the soil and rock, the K-40 naturally occurring background concentrations include values greater than 27 pCi/gm in granitic rocks, and average 10.8 pCi/gm in soils. The range and variability evident in the fill soils analyzed appear to be consistent with these values, particularly when referring to background values in the urban fill.

"Report"

4. **Volume I, Executive Summary**
- Page iii, para. 2 - It should be stated in the text that Ra-224 has no gamma emission and, therefore, will not be detectable with gamma spectral analysis. State the surrogate.

The following revision has been made to the referenced paragraph to identify the surrogate detections.

"The gamma spectral analyses measured concentrations above minimum detectable levels for eleven nuclides. K-40, Tl-208, Pb-210, Pb-212, Pb-214, Bi-212, Bi-214, Ra-224 (surrogate detection by Pb-212), Ra-226 (measured as Pb-214), Ra-228 (measured as Ac-228), and U-238 (measured as Th-234) were detected frequently enough to be confidently identified."

- page iii, para 3 - The text should deal with the fact that U-235 at 12.8 pCi/g is extremely high, not indicative of background levels. Explain why this level is so high.

The U-235 concentration of 12.8 pCi/gm by gamma spectroscopy has an uncertainty of $\pm$18.7 pCi/gm, resulting in a possible concentration between 0 and +30 pCi/gm. Note that this sample is not from a background location and is not represented as a background level. That sample, CD-S78E18N-2-3, was reanalyzed for uranium isotopes by alpha spectroscopy. The Case Narrative reports that the comparison of the U-234, U-235 and U-238 results indicate the sample is of natural isotopic ratios and is not enriched. Additionally, in all of the samples analyzed, the U-234 and U-238 results are nearly identical, further indicating the absence of any enrichment or depletion. The text has been revised to reflect these results, which are also included in Table 5a.

5. **Volume 1, Section 3.1.1. - The discussions for Areas 3, 4, 5, 7, 8, 9 and 12 should make note that contaminants appear to go beyond the area boundary. In the case of areas 7 and 12 this indicates potential offsite contamination. Paragraph 2, sentence 2 on page 20 should reflect this as well.**

The discussion for areas 3, 4, 5, 7, 8, 9 and 12 have been revised to reflect the potential for contamination beyond the area boundary. The revisions include comments regarding areas 7 and 12 indicating potential offsite contamination.

- Page 21, para 3, sentence 2 - It is a major omission to not have recorded and reported data that would deal with the potential for offsite contamination. The fact that there are still somewhat elevated readings over the concrete south of Region 7 is significant.

The omission is acknowledged.

6. **Volume I, Section 3.4.1, page 32, para 3 - After decades in situ, it is very surprising that the Thorium Decay Chain is not in equilibrium. What explanation is offered for this?**

When analytical uncertainties are taken into account, and a small, systematic error in the ITAS/Quanterra gamma spec data is considered, the results indicate that the Thorium Decay Chain is in secular equilibrium.

7. **Table 4, Gamma Spec Analysis - Explain why, when the Ac-228 line is so strong, that there are data gaps in the Ra-224 data.**

In that a surrogate is needed for Ra-224, the Quanterra gamma spec report failed to identify the Pb-212 photo-peak which Quanterra uses to measure and report Ra-224. The Ra-224 concentration can be calculated from other photo-peaks in Quanterra's gamma spectroscopy report included in Volume III of this report.

- Explain in a footnote that Ra-228 does not have a gamma emission and, therefore, has been found from another radionuclide's gamma.

The requested footnote has been added to Table 4.

- The Tl-208 data has not been corrected for branching.

We acknowledge that the Tl-208 data has not been corrected for branching. A footnote to that affect has been added to Table 4.

- There are no footnotes 1, 2, 3.

Footnotes 1, 2 and 3 have been added to the first page of Table 4.

- Table 5 - Normally the U-235 activity is about 4.5% of the U-238 level. There should be a discussion on why sample CD-S156E49N-2-3 is at only 2.4% and sample CD-S78E18N-2-3 is at 24.5%. The latter is a significant departure that could influence cleanup protocols and the number of cleanup criteria.

See response to Comment 4 regarding analytical uncertainly. When uncertainties are taken into account, the relationship between U-235 and U-238 activities is ambiguous.

The uranium isotope ratio was reanalyzed by alpha spectroscopy. The case narrative reports that the U-234, U-235, and U-236 results, when compared for each sample, indicate the sample exhibits natural isotopic ratios with no evidence of enrichment. Additionally, in all the samples analyzed by alpha spec, the U-234 and U-238 results are nearly identical, further indicating the absence of any enrichment or depletion.

Table 5a has been added to present the uranium isotope by alpha spec data. The alpha spec data are included in Attachment E.

- Table 6 - An explanation should be given as to why the Th-230 results do not conform to the U-238 and U-234 results.

See response to Comment 4 regarding analytical uncertainties. All results on Table 6 include large uncertainties. Additionally, processing of the monazite ore which occurred on the site would have separated the Thorium-230 from the uranium. No revision to the report is proposed.

8. **Figures 3-14 and 3-14A - Elevated data in linear north/south and east/west lines on these figures should be discussed. Does this pertain to subsurface features such as piping?**

The linear features, both north/south and east/west result from the software used. A comment to this affect has been added in Section 3.1.2. The area alignments, generally east/west, appear to be coincident with the storm drain. This is best illustrated in Figure 3-1.

9. **Equilibrium Charts - All these charts show disequilibrium in the thorium series. This would not be expected based upon the decades the thorium has been in the ground. An explanation should be offered.**

The explanation of the apparent disequilibrium in the thorium series is that the results suggest a small systematic error in the Quanterra gamma spec analysis. The existence of that small systematic error does not affect the utility of the analytical results. Acknowledging the small systematic error, the data are consistent with equilibrium, within the analytical uncertainty. No revision to the report is proposed.

10. **Volume III, Data Summary, page 0000002, Quanterra Data Table - There are unit problems in this table. Under the heading Aliquot, grams and liters should not be tied together without identifying the form of the sample. None of the time related columns has units.**

The Data Summary Table pages, page 2 for isotopic uranium and page 1 for isotopic thorium, have been revised. New pages from the laboratory specify the aliquot units as grams (deleting reference to the option to use liters), and indicate the time units as minutes where previously no units were specified.

We appreciate the opportunity to work with you on this project. Please contact the undersigned with any further questions regarding this matter.

Sincerely,

STS CONSULTANTS, LTD.

Richard G. Berggreen
Principal Geologist

Attachment

chcproj.27313-ZH.revcomts.wp5.jm

AFFIDAVIT

In accordance with the requirements of Paragraph 24 of the Administrative Order by Consent for the Lindsay Light II Site, Chicago, Illinois dated January 27, 1994, the undersigned certifies under penalty of law that based on personal knowledge and appropriate inquiries of all other persons involved in preparation of the report entitled "Report for Characterization Investigation Gamma Radiation Survey, Lindsay Light II Site, 316 E. Illinois Street, Chicago, Illinois", dated October 13, 1995, the information submitted is true, accurate and complete, to the best of my knowledge and belief.

Certified by: Richard G. Burggren

Date: October 13, 1995

Notarized by: _____

My Commission Expires: _____

(Seal)

TABLE OF CONTENTS

VOLUME I

TABLES

*Following Text. Complete laboratory results in Attachment E.

REPORT FOR CHARACTERIZATION INVESTIGATION
GAMMA RADIATION SURVEY
(REV. 2)

LINDSAY LIGHT II SITE
316 E. ILLINOIS STREET
CHICAGO, ILLINOIS

EXECUTIVE SUMMARY

This report presents the results of a site characterization investigation of the property located in downtown Chicago, Illinois, bounded by East Illinois Street on the south, East Grand Avenue on the north, North Columbus Drive on the west, and North McClurg Court on the east. This report is the result of the implementation of the Work Plan for Site Characterization Investigation, approved by USEPA May 13, 1994. The objectives of the investigation were to identify the location and distribution of contamination at the site, document the concentration and source of radioactive materials at this site, and determine whether the material exhibited characteristics of hazardous waste.

The areal distribution and location of the radiological contaminants were evaluated through an overland gamma radiation survey of the site using both a sodium iodide (NaI) detector and a tissue equivalent doserate instrument. These surveys were conducted site-wide on a 6 x 6 meter grid and on 1 x 1 meter grids for areas exhibiting elevated gamma readings.

The surface survey results show consistently low background readings with distinct and elevated gamma readings greater than the average background plus two standard deviations in a few discrete areas. These data suggest the surface surveys are capable of identifying the areas of gamma-emitting materials with an accuracy of about 1 to 2 meters for the contamination borders. The overland survey measured gamma radiation ranging from background levels of 2484 counts per minute (CPM) at 1 cm elevation to over 100 times area background level, maximum reading of 6.26×10^5 CPM. The largest area and the area exhibiting the highest readings was the previous location of the stable building which had housed the Lindsay Light operations. An additional eleven (11) smaller areas also exhibited elevated gamma readings. Recognizing that the

Lindsay Light operations occupied the building for more than 15 years (from 1916 to 1932) the walls and floors of the building may have become contaminated by the monazite sand which was stored and processed in the building incidental to Lindsay's gas mantle manufacturing operations. The smaller areas separate from or adjacent to the building footprint may represent monazite sand-contaminated debris from the building spread as a result of demolition and subsequent site grading. These areas may also have been contaminated due to the sand, the processing residues, the thorium nitrate, or gas mantle parts spilled or discarded during transportation or handling of these materials.

The surface radiation data were evaluated and eight locations selected for down-hole gamma surveys to explore the vertical extent of the radioactive materials. The down-hole gamma logs generally extended to as deep as 6.5 meters, and one which reached a maximum of 9.6 meters. Several profiles encountered obstructions which prevented deeper penetration. One complete profile was surveyed at an apparent background location; three complete profiles and two obstructed profiles were surveyed at transitional gamma radiation locations (one of the complete profiles may reflect background conditions); and two complete profiles and one obstructed profile were completed at locations showing elevated gamma radiation readings. Soil samples were collected from one background location, two transitional locations and two locations showing elevated gamma radiation. Laboratory analyses were conducted for waste characterization and radioactive evaluation.

The vertical profiles of gamma radiation that showed the elevated gamma levels are limited to the upper 2.5 meters, with the majority of elevated profiles occurring from 0.5 to 1.5 meters below the ground surface. Subsurface background levels were generally less than 50 counts per second (CPS) (less than 3000 CPM). Transitional levels were in the range of 800 to 1000 CPS (48,000 to 60,000 CPM). Elevated gamma locations measured 9000 to slightly more than 11,000 CPS (540,000 to more than 660,000 CPM). In several transitional and elevated gamma profiles, two maxima were noted, suggesting two layers of contamination at depths of approximately 1 meter and 2 meters.

These overland gamma and down-hole gamma surveys define in general terms the distribution and location, both horizontally and vertically, of the radioactive contamination.

Analysis of the soil samples consisted of three components: gamma spectroscopy (spec) analysis, isotopic thorium and isotopic uranium analysis, and RCRA hazardous waste characterization. The two samples tested for RCRA hazardous waste characterization did not exhibit results which would cause the material to be classified as hazardous waste.

The gamma spectral analyses measured concentrations above minimum detectable levels for eleven isotopes. K-40, Tl-208, Pb-210, Pb-212, Pb-214, Bi-212, Bi-214, Ra-224 (surrogate detection by Pb-212), Ra-226 (measured as Pb-214), Ra-228 (measured as Ac-228), and U-238 (measured as Th-234) were detected frequently enough to be confidently identified. These isotopes are either naturally occurring isotopes, can be readily identified as counting artifacts, or are present in the natural decay chains (radionuclide breakdown products) of uranium and thorium, present in the monazite sand suspected as the source of the contamination.

The three highest gamma spec measurements were subsequently analyzed for isotopic uranium and isotopic thorium. The elevated gamma radiation samples measured maximum concentrations of 71.5 pCi/gm U-234, 12.8 pCi/gm U-235, 52.3 pCi/gm U-238, 334 pCi/gm Th-228, 263 pCi/gm Th-230, and 342 pCi/gm Th-232. Reanalysis of the highest gamma spec uranium concentration sample by alpha spectroscopy measured 89.6 pCi/gm U-234, 10.4 pCi/gm U-235/236, and 82.8 pCi/gm U-238. Total uranium and total thorium background concentrations in soil in the Chicago area vary from less than 1 to about 3 pCi/gm (Myrick, et al., 1981; NCRP, 1975; NCRP, 1987). The measured concentration of uranium and thorium isotopes indicate these elements exhibit isotopic ratios which show no evidence of uranium enrichment and are considered reasonable for soils containing materials contaminated with monazite sand. On the basis of the gamma spec and isotopic uranium and isotopic thorium analyses, there is no indication of a radioactive contamination source other than the monazite sand containing naturally occurring thorium, uranium and their respective breakdown products.

A rudimentary risk assessment was performed based on the doserate data collected with the tissue equivalent instrument capable of responding to gamma ray energies from 17 KeV to 1.3 MeV. The only plausible exposure scenario for the site in its present use as a paved parking lot is from direct exposure of lot attendants or lot patrons. Under the most unlikely exposure conditions, the annual dose to an individual would not exceed 4 mrem/yr, whereas a more reasonable scenario associated with the most elevated location on site predicts a dose much less than 1 mrem/yr. That scenario has the individual parking at the exact location of the most elevated gamma reading 165 μ Rem/hr, 50 days a year (this assumes he/she is able to occupy this same parking location approximately 20% of the time), standing on the location for 5 minutes each day (165 μ Rem/hr x 50 days/yr x 5 min/day x 1 hr/60 min. = 687.5 μ Rem/yr or 0.7 mrem/yr). It should be noted that the footprint of this elevated location is about 6 inches in diameter and is located in a parking space where the car's engine or trunk would normally be located. These facts render the exposure scenario for this site unlikely. Therefore, based on this basic assessment, the site in its present condition poses no additional radiological risk to lot attendants or patrons in excess of that already present for general radiological (background) conditions associated with the downtown Chicago area.

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REPORT FOR CHARACTERIZATION INVESTIGATION
GAMMA RADIATION SURVEY
(REV. 2)

LINDSAY LIGHT II SITE
316 E. ILLINOIS STREET
CHICAGO, ILLINOIS

1.0 INTRODUCTION

1.1 Objective

This report presents the results of the investigation conducted at the 316 East Illinois Street site, herein referred to as the "Lindsay Light II Site" or "site", for the characterization of radioactive contamination. The objective of the investigation was to determine the type and relative quantities of radioactive materials present, the hazardous waste characteristics of those materials, and the distribution or location of these materials at the subject site.

1.2 Site Description and Site History

The Lindsay Light II site at 316 East Illinois Street in downtown Chicago, Illinois, extends from East Illinois Street on the south to East Grand Avenue on the north. It is bounded by Columbus Drive on the west and McClurg Court on the east. Figure 1-1 is a location map, indicating the location of the property within the State of Illinois and the City of Chicago. Figure 1-2 shows the general layout of the site. The dimensions of the site are 66 meters (208 feet) north to south, and 186 meters (591 feet) east to west which makes the site approximately 12,276 m^2 (2.7 acres).

The property is presently undeveloped and has been used as a parking lot in recent years. The parking lot is paved with asphalt and has guard rails that border it. The property is situated in an urban area, surrounded by commercial and residential

buildings. A shopping mall is located approximately 200 feet to the southeast. The Chicago River is located 1/4 mile south of the site, and Lake Michigan is about 1/4 mile east of the site.

The Chicago Dock & Canal Company was founded in 1857. The Chicago Dock & Canal Trust, the direct successor of The Chicago Dock & Canal Company, is a real estate investment trust formed in 1962. Both companies are included in the reference to "Chicago Dock". Chicago Dock records indicate that a portion of the property was leased to the Lindsay Light Company from about 1915 to 1932. These records also indicate that the property from 316 to 322 East Illinois was rented by Cooper's Stable prior to 1913. A two-story building on the property housed a stable for horses and wagons and a blacksmith shop (Figure 1-2).

In 1914, the Cooper Stable was divided in half, from east to west. The south half, fronting on Illinois at 316 East to 322 East, was leased by Lindsay Light. Chicago Dock's records indicate that Lindsay Light made rent and tax payments on this property until about 1932. The building was demolished around 1933, which is consistent with the cessation of rent payments by Lindsay Light.

Review of property records indicates that Lindsay Light probably performed its primary manufacturing operations in this area of Chicago at 161 East Grand Avenue, about one-quarter mile west of the property. The operations at 161 East Grand Avenue included the manufacturing of incandescent gas mantles. Some manufacturing and/or processing of thorium-bearing monazite sand reportedly took place at the 316 East Illinois site.

A principal ingredient in gas mantle manufacture is thorium as a nitrate. Small amounts of cerium, beryllium, and magnesium nitrates are also used. Thorium was extracted from the monazite sand using an acid bath. The gas mantles were then dipped into a solution containing the thorium nitrate to increase the mantle's incandescent strength.

Thorium occurs in nature principally as the parent radionuclide Thorium-232 in association with its daughter products in a decay sequence known as the Thorium Decay Series. Several thorium isotopes are also found within the Uranium and

Actinium Decay Series. It is believed that the principal source of contamination at this site is Thorium-232 and thorium decay series nuclides.

1.3 Previous Investigations

In June 1993, the USEPA and Illinois Department of Nuclear Safety (IDNS) measured gamma radiation levels on portions of the site. The USEPA and IDNS survey was conducted based on information USEPA and IDNS had in their files which indicated Lindsay Light formerly had operations at the site. Several areas of gamma radiation levels above the vicinity background levels were indicated (Figure 1-3). A similar reconnaissance survey was conducted by STS for Chicago Dock in June 1993 which also found several areas of elevated gamma measurements. The results of the surveys suggested the presence of a subsurface gamma radiation source. Subsequently, a Work Plan was developed to conduct a comprehensive investigation of the source of the contamination. The investigation, completed through implementation of the Work Plan, was conducted with the objectives of identifying the type and quantity of the radioactive material, and the location and extent of the contamination.

1.4 Administrative Order by Consent

On January 27, 1994, an Administrative Order by Consent (AOC) was agreed upon by USEPA and Chicago Dock. The AOC required preparation of a Work Plan for site investigations. That Work Plan was prepared and, following review and revision in response to review comments, was approved by USEPA on May 13, 1994. This report is the result of the implementation of the work conducted in accordance with the Work Plan.

2.0 SCOPE OF WORK

The work scope as defined in the Work Plan consisted of five principal tasks. These tasks were:

- Site grid lay-out
- Overland gamma survey
- Down-hole gamma logging
- Soil sampling
- Chemical analysis

The following sections, Section 2.1 through 2.5, describe the specifics of these work scopes. Sections 3.1 through 3.4 present the results of the survey, sampling and analysis tasks.

2.1 Site Survey

A site-wide 6 x 6 meter grid was surveyed on May 14, 1994. The purpose of this site-wide grid was to establish accurate location points for surface radiation measurements, locating down-hole survey stations, and positioning borings for soil sampling. The grid was laid out by Certified Surveys, land surveyors licensed in the State of Illinois. The approved Work Plan specified a 30 x 30 meter grid be surveyed. However, rather than surveying a grid on 30 meter centers from which a 6 x 6 meter grid could be located, the grid was laid out at a 6-meter spacing site-wide. Each 6-meter station was marked with an orange spray paint spot. Every 3 to 4 stations were labeled with the north and east grid coordinates to facilitate data collection during the survey. The 0-0 point is located approximately 2 meters south and 1 meter west of the southwest corner of the parking lot guard rail. Survey nails were placed in the sidewalk to mark the corners of the survey grid.

The approximate location of the former stable building was obtained from 1905 Sanborn fire insurance maps of the property as part of a 1992 environmental assessment (STS 1992). That location was surveyed and marked and is assumed to be

accurate within a few feet. A 1 meter grid was surveyed and marked using green spray paint within the footprint of the former stable building, an area of approximately 30 meters by 30 meters. The survey grid is shown on Figure 2-1.

During the course of the overland gamma survey, additional 1-meter survey grids were established around locations where elevated readings were noted. Those smaller grids were laid out from the 6 x 6 meter grid stations using a rope marked in 1 meter increments. Stations were marked by spray painting spots on the ground at each 1 meter interval.

An elevation survey was not conducted since a site survey with elevations to 0.1 feet was available from The Chicago Dock & Canal Trust. The site elevation survey is included as Figure 2-2.

2.2 Overland Gamma Radiation Survey

2.2.1 Survey Methods

Two types of overland radiation surveys were conducted. One survey, conducted May 14, 15 and 21, 1994, measured gamma radiation levels using a Ludlum 44-10 2x2 inch NaI detector coupled with an ESP-1 portable ratemeter/scaler. The NaI detector measured gamma radiation in counts per minute (CPM). The second survey was conducted May 21 and 22, 1994, and used a Bicron microRem LE tissue equivalent doserate meter, which measured the tissue equivalent radiation dose in microRem/hr. The ESP-1/NaI surveys included readings at 1 meter elevation and at ground surface (1 cm elevation), while all Bicron measurements were collected at 1 meter elevation only.

The 6 x 6 meter site-wide grid was surveyed using the Ludlum 2x2 inch NaI detector with 1 minute measurements taken at 1 meter and 1 cm from the ground surface. Once all grid measurements were completed for each north/south row, an inter-grid survey was performed for each square formed by the 6 meter grid points. Inter-grid surveys were performed at a traverse speed of approximately 3 feet per second ($\pm$1 m/sec.). The survey instrument was held as close to the surface as possible and the grid surveyed

in a "zig-zag" pattern. For all inter-grid surveys, the ESP-1 external speaker was activated to provide an auditory indication of any increase in count rate, since this method is more sensitive than observing the ratemeter liquid crystal display (LCD) for subtle count rate changes. Areas discovered in the inter-grid surveys which showed increased count rates were marked with an "X" or several "Xs" at the location(s) of the highest reading(s). Once the 6 meter and inter-grid surveys were complete, detailed one meter grids were laid out around the "Xs" using a rope marked at one meter intervals and the 6 meter markings for reference.

In addition to the 1 meter grid layout over the former stable building footprint, eleven (11) additional areas of above background readings were identified by the inter-grid surveys. All twelve of the 1 x 1 meter grid areas were surveyed using the NaI detector with all measurements taken at 1 cm (ground surface). Measurement times for the 1 meter grid areas varied from 1 minute to as low as 15 seconds in the high activity areas. All measurements were then normalized to CPM and background subtracted to give the net CPM for comparison to the range of area background based on statistical considerations.

The twelve 1 x 1 meter grid areas were also surveyed using the Bicron microRem LE meter. All measurements were made at 1 meter from the ground surface. To allow for proper instrument response on the lowest measurement range, the instrument was held at each location for approximately 15 seconds. This allowed the instrument to reach at least 90 percent of the final reading.

Details of the overland gamma and doserate surveys including instrument calibrations and field checks are described in detail in Attachment A.

2.2.2 Determination of Site Background

Background levels of gamma radiation were established by means of a survey of stations along three traverses, each consisting of 12 stations. The background surveys were conducted May 14, 1994. The three traverses include one along the west margin of the parking lot, one located immediately east of the site and one on the sidewalk east of McClurg Court, station 207E from 0 to 66N. The east side of McClurg Court is

referred to as the off-site traverse. The two on-site traverses are located along the eastern-most and western-most margins of the site, at 0E and 187E from 0 to 66N. Figure 2-1, the site survey grid, shows the location of the background survey traverses.

Attachment A presents calculation of background values as the mean of the three traverses plus 2 standard deviations. Further discussions of the background values are presented in the Results, Section 3.0 and Attachment A.

2.2.3 Data Management

All NaI scintillometer data were plotted on spreadsheets (Attachment A). Two- and three-dimensional illustrations of the measurements were also prepared. These data were used to select proposed locations for subsequent investigations (down-hole gamma logging and soil sampling). The scintillometer data were also provided to USEPA representatives for preliminary review prior to selection of proposed locations.

The Bicron doserate measurements were collected concurrent with the down-hole and soil sampling work and were not used in the selection of sampling locations. The NaI and Bicron data are presented and discussed in Section 3.1, Overland Gamma Survey Results.

2.3 Cone Penetrometer and Down-hole Gamma Logging

2.3.1 Methods

The Cone Penetrometer Test truck (CPT) was used in combination with down-hole geophysical logging of gamma radiation to provide vertical delineation of the extent of contamination. The down-hole survey was conducted May 21 and 22, 1994. The depth of the investigation extended below the surficial fill materials to the naturally occurring soils. The CPT holes extended a maximum of 9.6 meters (31 feet). Obstructions were encountered at several proposed locations. The obstructions ranged from shallow, less than 1 meter deep, possible floor slabs or pavements, to deep, on the order of 2.5 to 3 meters, possibly a basement floor slab. The following summarizes the locations where cone holes were attempted and the results (Table 1).

Table 1

Down-hole Gamma Survey Locations

Proposed Locations	Results
Background	
24E 12N	Obstructed. No log after 6 attempts.
156E. 48N	Logged at 157E 49N
Alternate Location	
72E 60N	Anomalous log results. (Drilled through obstruction and logged).
71E 59N	Partial log, obstructed.
36E 12N	Obstructed. No log.
Transitional	
82E 25N	Logged
62E 25N	Partial log, obstructed
171E 64N	Logged
Alternate Location	
76E 21N	Obstructed. No log.
89E 16N	Logged
Elevated Gamma	
81E 5N	Logged at 81E 6N (access restricted by perimeter guardrail)
78E 4N	Obstructed. No log.
78E 18N	Logged
78E 9N	Partial, obstructed
Alternate Location	
82E 15N	Obstructed. No log.
78E 25N	Obstructed. No log.

The CPT casing was hydraulically pushed to the desired depth, and the hole was geophysically logged to record gamma radiation levels in counts per second (CPS) as a function of depth. Logging speed was held at 2 meters per minute, which gave excellent resolution of both background and elevated gamma locations.

The CPT down-hole gamma survey used a Colog MXG logger equipped with electronically controlled winch assembly, computer interface, and a Mount Sopris Model HLP-2375-I gamma radiation probe. The Mount Sopris probe was equipped

with a 0.5x1.5 inch Nal(TI) crystal which is capable of providing vertical resolution of approximately 1.5 inches.

2.3.2 Quality Assurance

2.3.2.1 Sensitivity Test Runs

In order to evaluate the impact of the stainless steel casing on the sensitivity of the Colog gamma logging unit, a series of five sensitivity runs were made. Standardized thorium-containing soils in fixed geometries prepared for the West Chicago thorium contamination project were used as the calibration sources. Specifications for the preparation of the "calibration soils" were provided and are included as Attachment B. The Work Plan specified that the casing would be used if it could be demonstrated that the use of the casing did not diminish the gamma reading by more than 50 percent when compared to readings obtained with no casing.

The following presents the results of those sensitivity test runs.

Table 2
Influence of CPT Casing Evaluation

Drum No.	Counts/second with Casing	Counts/second without Casing	Percent Difference (Range)
CD-1	13-16 CPS	20-25 CPS	20-48%
CD-2	180-210 CPS	280-288 CPS	25-38%
CD-3	399-420 CPS	550-600 CPS	24-34%
CD-7	104-115 CPS	150-165 CPS	23-37%
CD-8	58-70 CPS	88-100 CPS	23-42%

These data indicate the gamma readings using the casing were diminished 23 to 40 percent on average, sufficiently below the 50 percent threshold which would have precluded use of the casing. As a result, casing was used in all the down-hole logging at the site.

Data were available on the concentration of the gamma emitting radionuclides in the calibration drums. Correlation of the counts per second readings with the reported standardized soil concentrations allows for the derivation of a calibration curve to be applied to the gamma counts and soil (Th-232 + Ra 226) concentrations at the Lindsay Light site.

Analysis of the calibration drum materials indicated total gamma emitter and Th-232 plus Ra-226 concentrations as follows for the five drums:

Table 3

Calibration Drum Radionuclide Concentrations *

Drum No.	Total Gamma (pCi/gm)	Th-232 + Ra-226 (pCi/gm)
CD-1	2.7	1.7
CD-2	53.5	48.0
CD-3	104.6	97.1
CD-7	29.6	23.4
CD-8	17.5	12.9

*Analysis of drum contents are included in Attachment B.

Plotting the Th-232 + Ra-226 concentration vs. measured counts for each calibration drum yields Figure 2-3. Figure 2-3 plots the average reading of the CPT probe in counts per second (CPS) versus the soil concentration of Th-232 + Ra-226 in pCi/gm. Best fit linear regressions were then added to the plot and the equations for the probe response with and without the casing were determined.

2.3.2.2 Replicate Gamma Logs

Replicate gamma log readings were obtained in borings through logging both the probe entering the hole and the probe being withdrawn from the hole. Where both "in and out" logs were recorded, both logs are presented side-by-side on the gamma log figures.

Additionally, one background boring 157E 49N, was logged on the first day of the down-hole logging effort, and then again at the completion of the down-hole logging task. This replication of the log on two different days was to assess the reproducibility of the logging runs and to evaluate potential impacts to the equipment after logging the transitional and elevated gamma locations.

Observations of the two runs (up and down) show excellent replication on most borings. One exception was boring 71E 59N. That log was run in a drilled boring, due to the presence of obstructions at a depth of approximately 2.5 meters. Non-replicate logs were obtained in several runs and are attributed to faulty connections between the probe and the recording unit. After the anomalous results were noted, the soil cuttings from the boring were screened with the NaI scintillometer and the Bicron tissue equivalent doserate meter. No elevated readings above background were measured in these cuttings, which tends to confirm the background nature of this location.

Comparison of the two logs run in the background boring to check the reproducibility of the logging following the end of the survey showed excellent reproducibility. No significant difference was noted in the logs run on separate days. This indicates no significant impact to the equipment resulted from the logging of the locations of suspected elevated gamma material.

2.4 Soil Sampling

2.4.1 Selection of Samples

Based on the results of the overland gamma survey and the down-hole gamma survey, locations and depths were selected for the collection of soil samples. The objective was to collect samples at one background location removed from any surface indications of contamination, two transitional locations where gamma readings are above the background but not among the highest values measured, and two locations exhibiting significantly elevated gamma readings. Samples were to be analyzed to identify the radioactive material, measure the activity, determine the soil concentration and correlate these findings with the down-hole gamma data. The overland survey information indicated the horizontal locations to be sampled. The down-hole gamma information indicated the depth where the highest gamma readings were recorded and samples would be collected.

The selected soil sampling locations are listed below. The depth of sampling is based on the zones which consistently exhibited the highest reading in the down-hole boring gamma logging. The proposed sample depth was from 0.65 meters to 1.3 meters (2 to 4 feet).

The following locations were chosen for soil sample collection:

Background	156E	49N
Transitional	82E	25N
	89E	16N
Elevated Gamma	81E	5N
	78E	18N

Duplicate samples were also submitted to facilitate assessment of the reproducibility of the analyses. Duplicates were prepared by homogenizing the sample recovered in the barrel of the split spoon and then filling two sets of sample bottles a little at a time

until both sets of bottles were full. Duplicates were prepared for two of the elevated gamma measurements, at 81E 5N from 0.65 to 0.95 meters (2-3 ft), and at 78E 18N from 0.95 to 1.3 meters (3-4 ft). In order to prevent the laboratory from recognizing these split samples as duplicates, the duplicate samples were coded with a 9 at the end of the sample number and the label and Chain-of-Custody indicated the samples were from a depth 20 feet deeper than the actual sample depth.

2.4.2 Sampling Methods

Samples were collected using a truck-mounted drill rig. Samples could not be collected as initially proposed using the CPT rig due to pavements and obstructions at the sample locations.

Drilling was conducted using solid flight augers. The sample was recovered by driving a 2.5 inch diameter split spoon sampler using an SPT hammer.

Upon recovery of the sample to the ground surface, the borehole depth was measured using a weighted tape. The split spoon was opened and the sample screened using the Bicron meter. The sample was also screened using an HNu photo-ionization detector (PID). The sample was then described and logged. The recovered material was homogenized using a stainless steel spatula blade and subdivided into the individual sample bottles.

Cuttings from the borings were screened using the Bicron meter. The levels were not recorded, but did exhibit elevated readings in the transitional and elevated gamma sample locations. All cuttings from the transitional and elevated gamma borings were placed in a bucket, segregated from other cuttings and materials generated as part of the investigation. The buckets were stored, locked in the on-site trailer. The material was utilized in testing of the physical and chemical properties of the soil. No soil materials remain on site.

All borings were grouted closed with a neat cement grout upon completion of sampling.

2.5 Analyses

2.5.1 Analytical Parameters

A total of 12 samples were submitted for analysis. Two samples were submitted from each of the five sampling locations. Two duplicate samples were also submitted. The samples were initially analyzed by gamma spectroscopy. All gamma emitters identified were reported.

The three samples showing the highest gamma spec detections were subsequently analyzed for isotopic uranium and isotopic thorium. In addition, one of the samples from the background boring was analyzed for isotopic uranium and isotopic thorium.

Two of the samples from the elevated gamma radiation areas were also submitted for RCRA hazardous waste characterization. The purpose of that analysis was to evaluate potential constraints on the eventual disposal of the radioactive material present at the site. Those analyses included TCLP volatiles, TCLP semi-volatiles, TCLP metals, reactivity, corrosivity and ignitability.

2.5.2 Quality Assurance

2.5.2.1 Overland Gamma Survey

Quality Assurance measures were performed in accordance with Quality Assurance procedures in Appendix D of the Work Plan. Per Section 3.2.2 of the Work Plan, duplicate measurements were conducted for approximately 10 percent of the 6 meter grid stations. QA measurements were made randomly across the site at surveyor-established 6 meter grid points using the ESP-1/44-10 instrument set detector (S/N 112642) with the 2.5 inch lead shield at a distance of 1 cm above the surface. All 6 meter grid QA data are shown in Appendix E of Attachment A. The site was walked randomly from west to east and north to south to north in a "zig-zag" pattern similar to the inter-grid survey technique. A total of 100 QA measurements were made, where only 36 measurements were required by the Work Plan. The additional measurements

were made to provide for a random sampling across the entire site versus only a portion of the site.

All QA measurements were collected for 30 seconds. Appendix D-6 of Attachment A gives the raw data as CPM and the percent difference between the Corrected QA CPM and Corrected Initial CPM, using the initial CPM as the "true" or expected value for the percent difference calculation. The result of percent difference test range from -31.8% to 50.77% with an overall average of -1.56 $\pm$ 12.3% at one standard deviation. These QA data show that the average variation is excellent and that 95 percent of the data are within an error range of less than $\pm$25 percent at 2 standard deviations. Given the fact that the QA measurements were made on a different day than the original measurements and that the majority of the QA data are in the range of site background, an error of only 25 percent at 2 sigma is considered to be acceptable.

Appendix G-4 of Attachment A presents a QA check to correlate ESP-1/44-10 readings with those of the Bicron microRem LE instruments at the most elevated reading measured on the site, near survey point 76E 4N. The highest Bicron contact reading was 650 μrem/hr at the surface. The average correction factor calculated for converting the ESP-1 countrate data to equivalent μrem/hr data was 487 CPM/μrem/hr at one meter above the surface.

2.5.2.2 Chemical Analytical QA/QC

Data validation was conducted for samples analyzed at the ITAS Laboratory. The laboratory reported results for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and inorganic parameters specified in the toxicity characteristic leaching procedure (TCLP). The compounds were analyzed according to methods for hazardous waste characteristic determination as specified by EPA SW-846. The sample analyses were reviewed for accuracy and completeness. Precision was not analyzed as only two samples were analyzed (CD-S81E5N-2-3 and CD-S78E18N-2-3) from the elevated gamma reading areas, as specified in the Work Plan.

Volatile Organic Compound QA/QC

Specific VOC compounds specified in TCLP were analyzed on the zero headspace TCLP extract. The samples were analyzed according to EPA SW-846 Method 8240. The samples were analyzed within two weeks of sample collection. The GC/MS tuning was completed and the acceptance criteria associated with injection of 4-bromofluorobenzene (BFB) for the initial calibration and sample analyses were within acceptable ranges. Neither the QC blank nor the extraction blank contained analytes of interest.

A laboratory control sample spike was completed and all of the spiked compounds were within QC acceptable ranges. This would be considered a measure of accuracy for the method. However, a matrix spike, which would provide a measure of accuracy for the sample matrix, was not completed.

Semi-Volatile Organic Compound QA/QC

Semi-volatile compounds specified in TCLP were analyzed according to Method SW 846-8270. The samples were extracted within one week of sample collection and analyzed within two weeks of sample collection. The samples, extraction blank, method blank and method spike had acceptable surrogate recoveries. No analytes were detected in the method blank associated with these samples.

The GC/MS tuning was completed and the acceptance criteria associated with injection of decafluorotriphenylphosphine (DFTPP) for both the initial calibration and samples were within acceptable ranges.

A laboratory control sample spike was completed and all spiked compounds were within the QC acceptable range. This could be considered a measure of accuracy, although a matrix spike was not completed for these samples.

Inorganic Analyses QA/QC

Inorganic analyses were completed as applicable by methodology stated in EPA SW-846. The initial and continuing calibrations were acceptable for all metals analyzed. The blanks that were reported associated with the metals analyses did not contain any analytes above the detection limit. Sample CDS78E18N23 reported barium above the instrument detection limit but below the CRDL, the normal CLP detection reporting limit. Sample CDS81E5N23 also indicated detects of barium and cadmium in the range between the instrument detection and the CRDL.

A laboratory control sample spike was completed for each metal that was analyzed. The results for the spiked sample were within acceptable limits. This could be considered a measure of accuracy, although a matrix spike was not completed.

Radiological Sample Analysis

The entire data analysis package sent from the analytical laboratory was checked against the laboratory's Quality Assurance Management Plan and procedures shown in Appendices A through E of the Work Plan. The QA review consisted of 100 percent of all data sheets and all calibration sheets forwarded by the lab. No discrepancies were noted in any of the data or analyses reviewed. QA review forms are included as part of Attachment E. Additionally, a laboratory internal memorandum regarding the rationale for not conducting matrix spike analyses on gamma spec analyses is also included in Attachment E.

3.0 INVESTIGATION RESULTS

3.1 Overland Gamma Survey

The overland gamma survey consisted of two surveys, one performed using a Ludlum ESP-1 with a NaI detector, and a second using a Bicron tissue equivalent doserate meter. Background measurements established typical levels remote from contaminated locations. Details of the methods used in conducting the overland gamma surveys and the survey results are presented in Attachment A. The following sections present the NaI survey, the Bicron survey, and a summary of the survey results including descriptions of the zones exhibiting elevated radiation readings.

3.1.1 NaI Ludlum Survey

Background gamma radiation values were calculated from measurements taken at 1 meter and 1 cm above the ground surface along three traverses including both on- and off-site locations. These background values were calculated to facilitate identification of anomalous surface gamma levels. In accordance with the Work Plan, a threshold was set at the mean of the background traverse readings plus two standard deviations ($\bar{m} + 2\sigma$). Background values were measured and calculated for the 1 meter and 1 cm elevations as follows:

$\bar{m} + 2\sigma$ (1 m) = 2818 CPM
$\bar{m} + 2\sigma$ (1 cm) = 3114 CPM

The 6 x 6 m station to station site survey combined with inter-grid surveys identified 12 areas exhibiting gamma readings which exceeded the background thresholds. These areas are identified on Figure 3-1. A full description of the survey results including tabulated records of all readings is included as Attachment A. These elevated locations were surveyed at a 1 meter grid interval with the detector at 1 cm elevation.

The areas of elevated readings have been presented as two- and three-dimensional illustrations of the net gamma radiation readings after background subtraction on Figures 3-2 through 3-13. A brief summary of each area is provided below.

Area 1 is located toward the northwest corner of the site. That area showed only one data point above the background plus 2σ ($\bar{m} + 2\sigma$) threshold (29E 60N). That reading was 4.56×10^3 counts per minute (CPM). Figure 3-2 shows the $\bar{m} + 2\sigma$ exceedance area.

Area 2 also showed only one data point above the $\bar{m} + 2\sigma$ threshold shown on Figure 3-3. That point at 42E 28N, measured 7.10×10^3 CPM.

Area 3 exhibits a series of elevated readings extending along 51E from 13N to 20N, Figure 3-4. The elevated gamma readings extend to the limits and possibly beyond the surveyed area to the west. Maximum readings in Area 3 are noted at 50E 17N (2.26×10^4 CPM) and 51E 19N (1.29×10^4 CPM).

Area 4, Figure 3-5, similar to Areas 1 and 2, has one point which exceeds the $\bar{m} + 2\sigma$ threshold. The elevated gamma reading is at the eastern edge of the survey area indicating elevated levels may extend beyond the survey area and connect with Area 5 to the east. Station 62E 20N measured 3.92×10^3 CPM. This Area is near Area 5 which extends west from the northwest corner of the former stable area.

Area 5 extending west from the footprint of the former stable has numerous measurements above the $\bar{m} + 2\sigma$ threshold (Figure 3-6). Elevated gamma readings extend to the limits and possibly beyond the surveyed area to the west and north. The highest reading is 3.70×10^4 CPM at Station 69E 27N. Several other readings are in the 10^4 CPM range.

Area 6 exhibits the highest reading outside the stable building footprint. Station 68E 7N measured 5.35×10^4 CPM. Figure 3-7 displays the gamma readings and background as $\bar{m} + 2\sigma$.

Area 7 designates the entire footprint of the former stable building. Note that the entire footprint does not display elevated gamma readings. Figure 3-8 shows the plot of values with the $\bar{m} + 2\sigma$ background. Figure 3-8a gives the 3 dimensional image of the gamma readings.

The highest values measured and the majority of values above background lay along the western third of the building area. The highest value measured on site was 6.26×10^5 CPM at 81E 5N. Farther west at 76E 4N, a maximum value of 4.94×10^5 CPM was measured.

The highest readings within the building footprint are generally located from 76E to about 85E. High readings extend nearly to the southern limit of the site, with the highest readings noted at 4 to 6 meters north of the southern boundary of the survey area. Note, however, that values tend to approach or fall below the $\bar{m} + 2\sigma$ threshold at the southern margin of the survey. Elevated gamma readings extend to the limits of the surveyed area and may extend beyond the site boundary to the south.

Area 8 which extends off the northeast corner of the former stable footprint shows several values in the 10^4 CPM range (Figure 3-9). Elevated gamma readings extend to the limits of the surveyed area and possibly beyond the area boundary to the northwest. Two values at 106E 26N, and 27N approach the maximum values measured in Area 6. Station 106E 26N measures 5.22×10^4 CPM while 106E 27N measures 5.15×10^4 CPM. Several high values near the northeast end of Area 8 are located at 24N to 27N between 114E and 119E.

Area 9 shows several data points which exceed the $\bar{m} + 2\sigma$ threshold (Figure 3-10). Elevated gamma readings extend to the limits of the surveyed area and may extend beyond the surveyed area to the east. The highest value measured was 1.77×10^4 CPM at 134E 33N. The elevated readings trend along an east-west orientation at about 33N running from 132E across to 137E. A similar east-west alignment of higher readings is noted from 135E to 138E at about 26N.

Area 10 shows several points which exceed the $\bar{m} + 2\sigma$ threshold (Figure 3-11). The highest value measured in Area 10 is 1.08×10^4 CPM at station 134E 13N.

Area 11 showed one data point, 140E 14N, which exceeded the $\bar{m} + 2\sigma$ threshold (Figure 3-12). The highest measurement in Area 11 was 4.46×10^3 CPM.

Area 12 showed a number of elevated readings (Figure 3-13). One of the highest, 2.97×10^4 CPM, was measured along the northern margin of the site at station 170E 66N, indicating elevated readings may extend beyond the site boundary to the north. The highest value was measured near there at 171E 64N, where a value of 4.35×10^4 CPM was recorded.

The limits of the 1 meter gridded areas were set based upon several considerations. The inter-grid survey identified locations with elevated readings and the survey grid was laid out around those locations. In some areas where several elevated readings were sufficiently close, they were included in a single gridded area. In other areas, separate grids were surveyed around elevated gamma locations. Where different grid areas approach but do not overlap each other, i.e. areas 4 and 5, the gap between areas is sufficiently small to be insignificant. Where elevated readings extend to the edge of the 1 meter grids within the 6 meter grid, the absence of elevated readings detected in the inter-grid survey indicates the readings dropped to background levels. Additional survey points may have provided minor added detail to the margin of the elevated gamma area, but, in the opinion of the investigators, would not have documented additional contaminated areas. Inasmuch as the objective was to document the apparent limits of the gamma radiation source areas, these data are considered sufficient to make that demonstration.

In areas where the elevated readings extended beyond the limits of the 6 meter gridded area, specifically south of area 7 and north of area 12, the inter-grid survey does not provide documentation of background levels. These off-site areas were surveyed by MJW Corporation, but no data were recorded or provided for this report. These areas were described as exhibiting background values to the north of area 12, and somewhat elevated readings 1 to 2 meters to the south of area 7 before dropping to background levels. It was noted that both areas were concrete sidewalk paved rather than the asphalt paving which covered the majority of the site. The concrete pavement was anticipated to be a more effective cover, precluding direct comparison of gamma readings between the asphalt paved areas and the concrete sidewalks. It was further

noted that at the request of USEPA on-site personnel, the excavation spoil from utility trenching on East Grand Avenue to the north was screened for elevated gamma readings. All materials screened were at background levels.

3.1.2 Bicron Survey

Bicron instrument surveys were made over those areas showing elevated gamma readings and in the footprint of the former stable building. Background values were obtained as with the Ludlum NaI scintillometer at the three traverse locations. General area Bicron background readings were 4.5 μrem/hr. The background threshold was calculated as follows:

- background mean plus two standard deviations ($\bar{m} + 2\sigma$) equals 7.25 μrem/hr

The results of the Bicron survey are included as tables and three dimensional plots of readings in Appendix A. The plots of the site-wide Bicron survey data are included as Figure 3-14 viewed from south to north, and Figure 3-14a viewed from north to south. Figures 3-14 and 3-14a exhibit some linear features aligned east-west and north-south. These features are the result of the graphing software used to prepare the figures.

The Bicron doserate data for the 12 areas show similar intensities as the scintillometer data. The $\bar{m} + 2\sigma$ threshold for the Bicron data was exceeded in 10 of the 12 areas, excepting Areas 1 and 2. The highest net reading at a 1 meter elevation, the elevation at which typical whole body doserate measurements are made, was in Area 7 at station 76E 4N, near one of the highest scintillometer readings. At that location and elevation, a value of 165.5 μrem/hr was measured. At that location, a surface (1 cm elevation) reading was taken which measured 650 μrem/hr.

3.2 Down-hole Gamma Survey Results

Down-hole gamma logs were attempted and either partially run or completely logged at 10 locations. Numerous other locations were precluded from logging due to subsurface obstructions such as concrete pavement, basement floor slabs, or massive debris in the

fill soils. Three partial records appear usable from holes encountering obstructions at depths of 2.5 to 3 meters (9 to 10 feet) Seven complete logs were run. These included one with inconsistent signals on re-runs which does not appear usable (discussed below under background logs). A second anomalous log shows background level gamma measurements in a log run in what was anticipated to be a transitional gamma level area, based on surface gamma survey data.

The down-hole gamma radiation logs are presented in Figures 3-15 to 3-24.

For most of the logs, replicate runs were recorded to allow for evaluation of the reproducibility of the data. Gamma measurements were recorded on a run into the casing, labeled "Gamma Log Dwn" on the left side of the gamma log Figures. The record of the readings upon withdrawal of the probe is labeled "Gamma Log Up" and is shown on the right side of the Figures.

Replicate logs were also run on the one check boring which was logged on both days of the down-hole survey. Replication between the logs run on the two days was excellent.

The scales used to display the gamma levels on the various logs vary by a factor of 10 between the background, transitional and elevated gamma logs. The background logs are shown with a full scale value of 120 counts per second (CPS). (Note the units in the down-hole gamma survey is counts per second, CPS, as opposed to counts per minute, CPM, for the overland survey. The absence of the overburden shielding produces this significantly greater sensitivity). The transitional logs are shown at a full scale reading of 1200 CPS. The elevated gamma records are shown at 12,000 CPS full scale.

The vertical scale on the logs is 1.1 meter to the inch.

3.2.1 Background Logs

At station 157E 49N, a background boring was logged which yielded excellent records (Figures 3-15 and 3-15a). Replicate runs into and out of the boring matched well, as did logs run the next day upon completion of the logging effort.

These logs indicate a relatively low gamma level ranging from less than 6 CPS to perhaps 25 CPS (360 to 1500 CPM) in the fill materials. Below a depth of approximately 2.5 to 3 meters (9 to 10 feet), the gamma levels are lower and much more constant at around 6 to 8 CPS (360 to 480 CPM), to a total depth of 6.5 meters, about 22 feet.

The log for boring 171E 64N (Figures 3-16 and 3-16a) exhibits a similar profile, although that log was anticipated to be a transitional gamma radiation location. Gamma levels ranged from maxima of less than 40 CPS (2400 CPM) in the fill soils above approximately 3 meters (9 to 10 feet deep) to a consistent 5 to 9 CPS (300 to 540 CPM) in the natural soils to a depth of 6.5 meters (22 feet). Consistent values were measured on both the log down and log up runs in this boring.

Attempts at a background boring at 72E 60N encountered repeated obstructions at a depth of about 9 to 10 feet. This was interpreted as a basement floor slab. In an effort to obtain a background gamma log at this location, a boring was advanced at 71E 59N, using a drill rig. A CPT casing was then placed in the boring and a series of gamma logs run.

These records show, in one set (Figure 3-17), a profile with some slight variation above 3 meters and relatively constant values from 3 meters to the bottom at 6.2 meters. This profile is similar to the background logs previously described, except that the recorded gamma levels were from about 147 to 165 CPS (8820 to 9900 CPM). This suggests a scale shift of approximately 140 CPS (8400 CPM) occurred on this record.

A second run (Figure 3-17a), gave dramatically different records for the log down and log up runs. The inconsistencies between the several logs suggest these logs are not usable in the evaluation of site conditions.

In order to evaluate whether the anomalous readings at this location were the result of elevated gamma levels, the cuttings which had been brought to the surface during the drilling of the bore hole were screened. The materials were screened using the Ludlum NaI scintillometer and Bicron tissue equivalent doserate meter by the health physics technician. No levels above background were noted in these cuttings.

The absence of a consistent record indicating the presence of contamination and the lack of any elevated radiation upon screening the cuttings indicate there is no evidence of radioactive contamination at this location.

3.2.2 Transitional Logs

The transitional gamma logs were obtained in areas where overland gamma results indicated increasing gamma radiation around the highest gamma readings, or areas exhibiting levels above background, but removed from the highest reading areas.

One of the proposed transitional areas was located at 171E 64N, in Area 12. That location was discussed above under background locations, since the log (Figures 3-16 and 3-16a) appeared characteristic of background locations and did not show the elevated gamma levels anticipated.

A second location in an out-lying area was logged for transitional gamma levels at 62E 25N, from Area 5. At that location, a fairly good profile (Figure 3-18) was obtained of the upper 2.7 meters, but was terminated at an obstruction. At that location, a gamma radiation peak signal at a level of 660 CPS (39,600 CPM) was recorded at 2.2 meters. Gamma levels dropped to approximately 340 CPS (20,400 CPM) at 2.5 meters, then began to rise again when the record was interrupted by the obstruction at 2.7 meters. Note that the high reading at a depth of 2.2 meters is the deepest horizon identified exhibiting an elevated gamma radiation level. The data record was consistent for this boring between the log down and log up records.

A second obstructed record is included from location 82E 15N. This location lies within the stable building footprint. The record at this location (Figure 3-19) is only for about one meter depth. The record shows a gamma peak of about 840 CPS (50,400 CPM) at 0.8 meters. The record shows a fairly sharp rise in counts below a depth of about 0.3 meters, a peak at about 0.5 to 0.8 meters and a fairly sharp fall off in readings to the end of the record at about 1.0 meter depth.

At location 82E 25N, the deepest profile on site was recorded. Gamma log measurements were made to a depth of 9.6 meters (31 feet). This profile (Figure 3-20)

shows low gamma readings to a depth of 0.4 meters, a steady rise with some gentle fluctuations to a distinct peak of about 840 CPS (50,400 CPM) at a depth of 1.2 meters, followed by an abrupt drop down to background levels of less than 10 CPS (600 CPM) below 2 meters. A slight rise in gamma levels to perhaps 10 to 20 CPS (600 to 1200 CPM) below 9 meters may signify a change in strata from lake shore sand to glacial clay till soils. It does not appear to be an indication of contamination due to the broad (shallow) nature of the data signal.

At station 89E 16N, also within the building footprint, a transitional log extended to a depth of 6.4 meters. This profile (Figure 3-21), run both log down and log up, displays a double peak in gamma readings. Gamma levels rise below a depth of 0.3 meters to a peak reading of approximately 1050 CPS (63,000 CPM) at a depth of 0.62 meters. Below that, levels drop to approximately 680 CPS (40,800 CPM) at 1.0 meter depth, then rise in a second peak to 840 CPS (50,400 CPM) to 1.2 meters deep. Below the second peak gamma reading, levels decline until at about 2.2 meters, a fairly constant reading of 10 CPS (600 CPM) or less is detected. These readings are mirrored in both records for this boring.

3.2.3 Elevated Gamma Logs

Three records were run on borings from locations of elevated surface gamma measurements. All three are from the western portion of the building footprint.

At station 78E 9N, a partial log was obtained to a depth of 3.3 meters before encountering an obstruction. That record (Figure 3-22) shows a very strong peak rising from low levels at 0.4 meters deep to a peak value of approximately 11,000 CPS (660,000 CPM) at a depth of just below 1.0 meter. Below 1 meter, gamma levels drop to about 600 CPS (36,000 CPM) at 1.8 meters before increasing slightly to 1200 to 1300 CPS (72,000 to 78,000 CPM) at about 2.1 meters. This peak is similar to the maximum level measured at 62E 25N where a 660 CPS (39,600 CPM) peak was noted at 2.2 meters. Below 2.1 meters, the gamma levels in the log at 78E 9N drop to background values by 2.5 meters deep and remain at that level to the bottom of the boring at 3.3 meters.

At station 78E 18N, the gamma levels show a single pronounced peak (Figure 3-23). Beginning below a depth of 0.4 meters, the readings rise to approximately 11,200 CPS (672,000 CPM), just above 1.0 meter. Readings then drop sharply back to background levels, and below 1.7 or 1.8 meters, show consistently low levels to the total depth of the log at 6.5 meters.

At station 81E 6N, two maxima are apparent in the gamma log (Figure 3-24). Below 0.4 meters readings rise sharply to a high of 9,500 CPS (570,000 CPM) at approximately 0.8 meters deep. Readings drop to a low of 3,700 CPS (222,000 CPM) at 1.3 meters deep, then rise to just over 6,000 CPS (360,000 CPM) at about 1.6 meters. Below 1.6 meters, readings drop to background levels below about 2.2 meters and remain low to the total depth of the log at 6.5 meters.

The distinct maxima noted on both the transitional logs and elevated gamma logs likely represent relatively thin horizons of gamma-emitting materials. The rise in gamma counts approaching these horizons is likely an example of the penetrating power of the radiation rather than a broad band of contamination. This is likely particularly true where the slope of the log is equally steep above and below the maximum value.

Where double peaks are evident, i.e., 81E 6N, or 89E 16N, these represent two distinct gamma-emitting concentration horizons, possibly a layer of fill placed over a former floor during the period of operations. The low reading between the two peaks represents where the "halos" of the two horizons intersect.

These down-hole logs appear to fairly accurately define the vertical extent of the gamma-emitting contamination in the areas tested. The distinct signature evident in both the obstructed (incomplete) and the unobstructed (complete) down-hole logs suggests that the character of the material can confidently be distinguished using the methods employed in this survey.

The principal unexplained anomaly was the absence of an elevated, transitional gamma record from station 171E 64N. It is possible that the source was sufficiently small and relatively shallow so as to be evident from the ground surface and apparent over some area, but was otherwise shielded and not detected in the subsurface.

The inconsistent and anomalous records in the several logs at the 71E 59N records are attributed to electrical problems with faulty connections between the detection and data recording equipment. That location was unique in that the log was run down a drilled hole into which a casing had been placed. The difficulty is not attributed to the drilled boring, but rather the logging equipment was set up in a configuration and location outside the CPT truck for this one boring. This set-up may have resulted in incomplete electrical connections or other logistical problems.

3.2.4 Summary of the Down-hole Gamma Survey Results

Figure 3-25 plots all CPT gamma log data from logged transition and elevated gamma boreholes against the depth at which the peak gamma intensity was recorded. Review of this plot shows that no gamma peaks occurred in the first one half meter, while 11 of 14 plotted gamma peak locations occurred within a one meter zone from 0.5 to 1.5 meters below grade. One of the three peaks occurring outside this one meter zone from 0.5 to 1.5 meters was located at 1.6 meters and two were located between 2 and 2.5 meters. Based on this population of subsurface testing in areas tens of meters apart, it is likely that the subsurface contamination patterns in untested areas are similar to those of Figure 3-25.

3.3 Soil Sampling

Soil sampling locations were selected from overland gamma locations, using those readings to select one background, two transitional, and two elevated gamma locations. The selected locations were:

156E 49N	-	Background
82E 25N	-	Transitional
89E 16N	-	Transitional
78E 18N	-	Elevated gamma
81E 5N	-	Elevated gamma

The down-hole gamma logging data were used to select the interval from which to recover the sample. The horizon of interest, i.e., that horizon showing the elevated gamma radiation, was generally around 1 meter deep. As a result, since two samples

were to be recovered from each of the boring locations, the sample intervals were set at 0.65 to 0.95 meters and 0.95 to 1.3 meters (2 to 3 feet and 3 to 4 feet).

Sampling was originally intended to be conducted with the CPT rig. However, obstructions were noted at sufficient frequency that a truck-mounted drill rig was mobilized to conduct the soil sampling. A Mobile B-55 drill rig equipped with solid stem auger was used to complete the soil sampling.

The asphalt pavement was drilled rather than being cored. The bore hole extended to the top of the interval to be sampled at 2 feet. A 2.5 inch diameter split spoon was driven with a standard penetration test (SPT) hammer through the 1 foot interval. The split spoon was recovered and the sample was screened for radioactivity, logged for soil type, homogenized and placed in the sample containers.

The borings all encountered fill materials below the asphalt pavement and gravel base course. Boring logs are presented in Appendix C. The fill consisted of sandy and clayey soil, cinders, wood, brick, mortar, wire and fragments of gravel. In Boring 82E 25N, a concrete pavement was encountered from 3.0 to 3.5 ft. The second sample in that boring extended from 3.5 ft. to 4.5 ft. In Boring 78E 18N, a wire mesh screen was recovered with the sample in a fragment of cement.

Radiation screening of the samples showed the samples from the elevated gamma areas exhibited μrem levels of between 55 and 170 and scintillometer readings of about 6 x 10^3 CPM (see Appendix B-5 of Appendix A).

Chain-of-Custody records for the samples submitted are included in Appendix D.

3.4 Analyses

The analysis of the soil samples consisted of two general components: radioactivity and RCRA hazardous waste characteristics. The radioactivity analysis was to assess the concentration and chemistry of the radioactive contaminants indicated as being present at the site. The RCRA hazardous waste characterization was to assess whether the

material exhibited any of the characteristics specified by regulation to classify material as hazardous waste.

3.4.1 Radiological Analysis

The radiological analysis consisted of two separate analyses. Gamma spectroscopy analyses were conducted on all samples submitted. Isotopic uranium and isotopic thorium analyses were conducted on the three samples exhibiting the highest gamma spec readings. Additionally, one of the background samples was analyzed for isotopic uranium and isotopic thorium. The objective of the gamma spec analysis was to detect and measure the concentration of all gamma-emitting radionuclides in the samples. The isotopic uranium and isotopic thorium analyses indicate isotopic ratios which can characterize the breakdown products (daughter isotopes) in each of the radioactive decay series. The individual isotopic analyses also have a greater sensitivity (lower detection level) than the gamma spec analyses.

In the gamma spec analyses, eighteen (18) gamma emitters were initially reported. However, three of these had consistent less than (<) values reported due to interferences from other radionuclides constraining detection. These were Th-230, U-234, and U-235. Four radionuclides were measured in only one or two samples, and at low levels, only slightly above the minimum detection level. These consisted of I-129, Ce-139, Ce-141, and Pa-234. Three of these (I-129, Ce-139 and Ce-141) are known fission products, were found to be the result of interference from other gamma or x-ray emitters, and were subsequently rejected. Pa-234 is naturally occurring (from the uranium chain). Ra-223 was found to be reported in error as a result of interference from Ac-228. The remaining ten radionuclides were above the minimum detection limit and were detected in a sufficient number of samples to be confidently identified as present. These compounds consist of: K-40, Tl-208, Pb-210, Pb-212, Bi-212, Ra-224, Ra-226, Ra-228, Th-228, and Th-234. Many of these radionuclides, namely Th-228, Ra-228, Ra-224, Pb-212, Bi-212 and Tl-208, are in the natural radioactive decay series of thorium. These elements are present in the monazite sand which was reported to have been stored and processed at the Lindsay Light operations formerly on site. Monazite also contains uranium to a lesser extent, represented by the uranium decay products Th-234, Ra-226, and Pb-210 in the identified nuclides.

Potassium-40 (K-40) is not a part of a decay chain. It is a naturally occurring radioactive isotope of potassium, accounting for 0.1 percent of all potassium.

The results of the gamma spec analyses are summarized in Table 4. The laboratory report of the gamma spec analyses is included in Appendix E.

The gamma spec analyses suggest the thorium decay chain products may not be in equilibrium. A compilation of the reported activities for each sample with positive results is attached as equilibrium charts, Figures 3-26 through 3-35.

A review of the equilibrium charts indicates that the Th-228 results are higher than Ra-228 results. This apparent anomaly could be due to the low abundances (1.2% and 0.2%) for Th-228 (Thorium Chain Nuclide identification parameters used by the analytical laboratory are presented on Table 4a). For most of the analyses, the Ra-228 and Ra-224 are showing equilibrium. The daughter products of Ra-224 (Pb-212, Bi-212, and Tl-208) should be in equilibrium within 2 days, based on a half-life of 10.6 hrs. for Pb-212. It is unexplained why the gamma spectrum shows Bi-212, and occasionally Pb-212, slightly lower than Ra-224 and Tl-208. The Tl-208 consistently shows a concentration at equilibrium with Ra-224 when corrected for percent of decay.

Samples were dried and weighed into petri dishes on 6-1-94. The samples were counted on 6-5-94; sufficient time to re-establish equilibrium following sample drying.

The gamma spec analyses show the lowest or non-detect concentrations in the background samples. No thorium isotopes were detected in the gamma spec analyses of the background samples. Only trace levels, less than 2 pCi/gm of one radium isotope, Ra-226, were measured in the background samples. The highest results, particularly for Pb, Ra and Th isotopes are noted in the samples recovered from the locations which measured the highest readings in the overland gamma survey. The highest readings, in several isotopes on the order of 2000 pCi/gm for Ra-224, Ra-228, and Th-228, were noted in the sample from 78E 18N at a depth of two to three feet. The other sample with readings around 1000 pCi/gm for Ra-224, Ra-228 and Th-228 was in the sample from 81E 5N from a depth of three to four feet. The sample from

81E 5N, from two to three feet was the third sample exhibiting elevated gamma spec readings which was selected for isotopic thorium and isotopic uranium analyses.

The three samples with the highest gamma spec readings were selected for analyses for isotopic thorium and isotopic uranium. Additionally, one sample from the background boring was also analyzed. Quality assurance testing at the laboratory resulted in that background sample being analyzed as a laboratory duplicate. A total of two background samples, duplicates from a single sample, and three samples exhibiting elevated gamma spec readings were analyzed for isotopic uranium and isotopic thorium. The background sample exhibited uranium isotope concentrations at or below laboratory background values for U-235, 1.12 to 1.89 pCi/gm U-234, and 0.502 to 2.14 pCi/gm U-238 in the duplicate analyses. The isotopic thorium results from those two analyses were very consistent between samples, 0.533(±0.135) and 0.556(±0.174) pCi/gm for Th-228, 0.70(±0.122) and -0.01(±0.003) pCi/gm for Th-230, and 0.337(±0.11) to 0.396(±0.143) pCi/gm for Th-232 in the background samples.

Isotopic uranium concentrations were fairly consistent in the three samples from the three elevated gamma locations. U-234 measured 71.5, 64.4 and 61.4 pCi/gm in the three samples; 78E 18N from two to three feet, 81E 5N from three to four feet, and 81E 5N from two to three feet, respectively. U-235 was less than the laboratory background value for all three samples. U-238 measured 52.3, 53.8 and 50.0 pCi/gm for the same samples. Isotopic thorium also showed relatively consistent values between the three elevated gamma samples. The sample from 78E 18N, two to three feet, however, showed the highest of all the three thorium isotopes. Maximum concentrations of 399 pCi/gm Th-228, 263 pCi/gm Th 230, and 342 pCi/gm Th-232 were measured in that sample. A complete tabulation of the isotopic uranium results is presented in Table 5. Isotopic thorium results are presented in Table 6.

The relative ratios between the uranium and thorium isotopes, on the order of 1:5 or 1:6 uranium to thorium, are consistent with the U:Th ratios found in naturally occurring monazite sand. Monazite sand was the source material from which the thorium was reportedly extracted at the 316 E. Illinois building operated by the Lindsay Light Company. Dr. David Dooley, principal of MJW, the health physics consultant

for this project, has concurred with the consistency of these findings and the indication of a monazite sand source. Additionally, the works of Eisenbud et al. 1964, 1973; Linsalata et al. 1985; Roser et al. 1964; and Wedow, 1967, support these nuclide ratios and relative concentrations as indicative of monazite sand materials.

There does not appear to be any indication of a radioactive contamination source other than the monazite sand and the associated uranium, thorium and their naturally occurring daughter (breakdown) products.

3.4.2 RCRA Hazardous Waste Characteristics

The classification of material as hazardous waste can be either a result of the material being specifically listed as a hazardous waste, or as a result of exhibiting a characteristic of hazardous waste. Four characteristics are designated for the determination of hazardous waste:

Reactivity
Corrosivity
Ignitability
Toxicity

The characteristic of toxicity (Toxicity Characteristic Leaching Procedure TCLP Test) has thresholds set and specific extraction methods proposed for three sets of parameters: Metals, Volatiles and Semi-volatiles. All three characteristics were analyzed on the samples submitted.

The determination of whether the material might be classified as a hazardous waste was of a concern for the subsequent management of the material, should off-site removal and disposal be proposed as a remedial measure in the future. Two samples from the elevated gamma locations were submitted for hazardous waste characteristic testing. These samples had to be selected before the radioactive analyses were conducted due to the volume of sample required for the analyses. The results of the waste characteristic testing are presented in Table 7.

None of the parameters tested for either sample submitted exhibited characteristics which would result in the classification of the sampled material as hazardous waste.

4.0 ELEMENTARY RADIOLOGICAL RISK ASSESSMENT

An elementary radiological risk assessment for the Lindsay Light II site shows that the only potential exposure pathway to members of the general public working at or using the site parking facilities is via direct exposure. The most concern would be for the parking lot attendants who man the cash booths. Both of the check-out booths on site are located in background areas and therefore, individuals working at these locations would incur no greater risk than anyone else in the downtown Chicago area with regard to direct radiation exposure. Further, these individuals are typically captive in the cashier booth due to the volume of business and they do not typically walk around the site during slow periods. Therefore, the most reasonable scenario for exposure becomes an individual member of the public who parks their car in the lot in the same location each day and which corresponds to the location of the highest Bicron reading of 165 μRem/hr at one meter from the surface. If we assume that this individual parks in this location 250 days per year and spends a minimum of 5 minutes per day outside the car directly over the highest measured location, the calculated annual dose would be 165 μRem/hr x 250 days/yr x 5 min/day x 1 hr/60 min. = 3,438 μRem/hr or 3.4 mrem/yr. This calculated dose would only apply to an individual who spent time outside the car without moving off the elevated location. This may be a reasonable scenario for summer months but seems more unlikely for winter months. Further, the likelihood of someone parking in the same location every day without a reserved parking space is very remote.

In a more realistic case where an individual only occasionally (say 20 percent of the time) parks in the location where he could be subjected to the maximum dose rate, the actual annual dose is likely much less than 1 mrem/yr (165 μRem/hr x (0.2 x 250 days/yr) x 5 min/day x 1 hr/60 min. = 687.6 μRem/hr or 0.69 μRem/yr). Such a dose satisfies all current as well as all proposed federal regulations concerning allowable doses to individual members of the general public from sources of residual radioactive material accessible by the general public in unrestricted areas. Under either the maximum exposure conditions or the realistic conditions, the site does not present a risk beyond that of the normal radiation environment in the downtown Chicago area.

5.0 CONCLUSIONS

The investigation of the 316 E. Illinois site had three principal objectives. These were to identify the apparent distribution or location of the contamination at the site, document the type and relative quantities of radioactive materials, and determine whether the material exhibited characteristics of hazardous waste.

The distribution and location of the radionuclide contamination is evident in the overland gamma survey results using a NaI scintillometer. These data identified eleven (11) relatively small areas and one (1) larger area with elevated gamma readings. The larger area appears to lie within the footprint of the former stable building. The western one-third of that building footprint exhibits the highest readings found on-site in the surface gamma survey. The remaining areas may be the results of tracking of radioactive material from the building during demolition of the structure and subsequent site grading. The more distant locations generally show lower levels of gamma radiation.

The overland survey of locations with elevated gamma radiation using a Bicron tissue equivalent meter showed similar elevated readings for most of the 12 identified areas. Background threshold values of $\bar{m} + 2\sigma$ were exceeded in 10 of the 12 areas (except areas 1 and 2). The highest reading was near the southeast corner of the building at station 76E 4N, where a reading of 165.5 μrem/hr was measured at a one meter (typical whole body dose) elevation. At that location, a surface (1 cm elevation) reading measured 650 μrem/hr.

These overland gamma survey results show consistently low background readings with areas of elevated gamma readings greater than the average background plus 2 standard deviations. These data suggest the surface gamma surveys using the 2x2 inch NaI scintillometer equipment are capable of identifying the areal extent of gamma-emitting materials on site with an accuracy of about 1 to 2 meters for the contaminant borders. The down-hole survey results show distinctly different gamma readings in background, transitional and elevated gamma areas. The consistency of the natural soils at depth and the shallow depth of all the materials showing elevated gamma readings indicates this method and equipment is capable of distinguishing the depth of gamma-emitting

materials in the subsurface. These data indicate that the material exhibiting the highest gamma radiation is at a depth of 0.8 to about 1.4 meters. The consistently low readings in the upper 0.4 meters, even in areas where the highest subsurface reading are measured, indicates this surface blanket of asphalt, base course gravel and fill is not a zone of contamination, but rather an existing barrier, isolating the contamination present at greater depths.

These overland gamma and down-hole gamma surveys define in general terms the distribution and location, both horizontally and vertically of the radioactive contamination.

The samples which were submitted for chemical analyses showed no characteristics which could result in their classification as hazardous waste. The radioactive analysis found the gamma-emitting radionuclides present are characteristic of the thorium and uranium decay series. The isotopic uranium and isotopic thorium analyses indicate the relative ratios of these elements are typical of the ratios which would be found in monazite sands from which thorium was reportedly extracted on-site.

On the basis of the gamma spec and isotopic thorium and isotopic uranium analyses, there is no indication of a radioactive contamination source other than the monazite sand containing naturally occurring uranium, thorium and their respective breakdown products. An elementary radiological risk assessment for the Lindsay Light II site shows that the only potential exposure pathway to members of the general public working at or using the site parking facilities is via direct exposure. Under either the maximum exposure conditions or the realistic conditions (discussed in Section 4.0), the site does not present a risk beyond that of the normal radiation environment in the downtown Chicago area.

6.0 REFERENCES

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RGB95:AD2:nls

Table 4
GAMMA SPEC ANALYSIS*
(concentration in pCi/gm)

Sample Number	Lab Number	K-40	Co-57	Co-60	Y-88	Cd-109	Sn-113	I-129	Cs-137
CD-S156E49N-2-3 [1]	5179-001	13.9							
CD-S156E49N-2-3 [1]	5179-001Dp	7.53							
CD-S156E49N-3-4 [1]	5179-002	12							
CD-S82E25N-2-3 [2]	5179-003								
CD-S82E25N-3-4 [2]	5179-004								
CD-S78E18N-2-3 [3]	5179-005	149							
CD-S78E18N-3-4-9 [3]	5179-008	35.1							
CD-S78E18N-3-4 [3]	5179-009								
CD-S89E16N-2-3 [2]	5179-006								
CD-S89E16N-3-4 [2]	5179-007								
CD-S81E5N-2-3-9 [3]	5179-010	42.1							
CD-S81E5N-3-4 [3]	5179-011	85.1							
CD-S81E5N-2-3 [3]	5179-012								

Sample Number	Lab Number	Ce-139	Ce-141	Hg-203	Tl-208**	Pb-210	Pb-212	Bi-212
CD-S156E49N-2-3	5179-001					1.56		
CD-S156E49N-2-3	5179-001DP							
CD-S156E49N-3-4	5179-002					1.84		
CD-S82E25N-2-3	5179-003				131	53	322	271
CD-S82E25N-3-4	5179-004				17.5		48.5	34.1
CD-S78E18N-2-3	5179-005				544		1250	1160
CD-S78E18N-3-4-9	5179-008				134	33.9	352	264
CD-S78E18N-3-4	5179-009				127	30.6	319	257
CD-S89E16N-2-3	5179-006				20.1	18.3	56.3	41.8
CD-S89E16N-3-4	5179-007				19.6		55.3	40.6
CD-S81E5N-2-3-9	5179-010				168		361	299
CD-S81E5N-3-4	5179-011				288	39.3	754	579
CD-S81E5N-2-3	5179-012				230	104	574	466

[1] - Background sample
[2] - Transitional sample
[3] - High Gamma sample

*Laboratory results in Attachment E.
****TR-208 has not been corrected for branching.**

RGB95:AD6:nls

Table 4
GAMMA SPEC ANALYSIS (cont.)*
(concentration in pCi/gm)

Sample Number	Lab Number	Ra-223	Ra-224	Ra-226	Ra-228 [4]	Th-228	Th-230
CD-S156E49N-2-3 [1]	5179-001			1.24	<1.12	<6.49	<18.6
CD-S156E49N-2-3 [1]	5179-001Dp			<0.334	<1.62	<17.4	<82.9
CD-S156E49N-3-4 [1]	5179-002			1.78	<1.14	<5.70	<15.7
CD-S82E25N-2-3 [2]	5179-003	~~67.6~~	393	60.7	418	543	<149
CD-S82E25N-3-4 [2]	5179-004	~~13.3~~		9.78	53.9	10.6	<248
CD-S78E18N-2-3 [3]	5179-005		1660	162	1850	2040	<252
CD-S78E18N-3-4-9 [3]	5179-008		406	47.2	443	438	<142
CD-S78E18N-3-4 [3]	5179-009	~~80.3~~	384	41.4	412	528	<147
CD-S89E16N-2-3 [2]	5179-006	~~11.7~~	48.5	15.1	65.5	85.5	<65.6
CD-S89E16N-3-4 [2]	5179-007			13.9	59.6	<53.1	<269
CD-S81E5N-2-3-9 [3]	5179-010	~~75.8~~		92.6	475	760	<679
CD-S81E5N-3-4 [3]	5179-011		964	39.1	965	1160	<195
CD-S81E5N-2-3 [3]	5179-012	~~123~~	631	131 741	936	<194	

Sample Number	Lab Number	Th-234	Pa-234	U-234	U-235	Am-241
CD-S156E49N-2-3	5179-001	<1.76		<57.2	<0.689	
CD-S156E49N-2-3	5179-001Dp	<3.61		<723	<1.18	
CD-S156E49N-3-4	5179-002	<1.92		<51.1	<0.614	
CD-S82E25N-2-3	5179-003	65.9		<392	<4.61	
CD-S82E25N-3-4	5179-004	35.9		<1850	<2.83	
CD-S78E18N-2-3	5179-005	159	579	<679	<7.96	
CD-S78E18N-3-4-9	5179-008	80.3		<361	<4.10	
CD-S78E18N-3-4	5179-009	73.8		<381	<4.53	
CD-S89E16N-2-3	5179-006	<3.59		<173	<1.93	
CD-S89E16N-3-4	5179-007	<7.20		<2040	<3.12	
CD-S81E5N-2-3-9	5179-010	<19.5		<5220	<8.14	
CD-S81E5N-3-4	5179-011	<12.5		<492	<5.75	
CD-S81E5N-2-3	5179-012	121		<514	<6.18	

[1] - Background sample
[2] - Transitional sample
[3] - High Gamma sample
[4] - Ra-228 does not have a gamma emission; concentrations are based on Ac-228 values.

*Laboratory results in Attachment E.

Table 5a

ISOTOPIC URANIUM BY ALPHA SPECTROSCOPY*
(concentration in pCi/gm)

Sample	Lab No.	U-238	U-235 U-236	U-234
CD-S156E49N-2-3	9369-001	1.62 ±0.55	0.08 ±0.12	1.66 ±0.56
CD-S78E18N-2-3	9369-002	32.0 ±6.8	3.25 ±1.08	30.0 ±6.4
CD-S81E5N-3-4	9369-003	82.8 ±17.2	10.4 ±2.6	89.6 ±18.6
CD-S81E5N-2-3	9369-004	52.4 ±11.1	7.47 ±2.04	51.1 ±10.8

*Laboratory results are in Attachment E. (Errors reported at 2 standard deviations)

RGB95:AD8:nls

INTERNATIONAL TECHNOLOGY CORPORATION

ITAS St. LOUIS
Isotopic Thorium Analysis

PROJ: 537.01

BATCH: 38993

ITAS St. Louis Lab
Revision Number 1
Start Date: 04/15/94

SAMPLE NUMBER	PREP DATE	ALIQUOT (g or l)	COUNT DATE	COUNT TIME	BKGD TIME	DET. NO.	EFF	ROI#1 Th-232	BKGD	ROI#2 TH-230	BKGD	ROI#3 TH-229	BKGD	ROI#4 TH-228	BKGD
LCS 38993	06-07-94	2.0000	06-08-94	200	4000	1	0.310	1018	71	1002	176	777	63	1138	94
BLK 38993	06-07-94	2.0000	06-08-94	200	4000	2	0.317	3	41	106	86	691	43	31	105
5179-001	06-07-94	2.0891	06-08-94	200	4000	3	0.307	58	141	212	208	658	121	86	108
5179-001DUP	06-07-94	2.0208	06-09-94	100	4000	8	0.310	36	62	59	114	389	32	51	102
5179-005	06-07-94	0.0104	06-08-94	200	4000	5	0.311	288	138	228	234	1425	59	334	122
5179-011	06-07-94	0.0101	06-08-94	200	4000	6	0.311	327	153	131	222	967	107	417	127
5179-012	06-07-94	0.0101	06-08-94	200	4000	7	0.308	227	89	105	153	903	59	260	91

TRACER pCi added: 9.01
LCS Th-232 pCi/matrix: 5.15
LCS Th-230 pCi/matrix: 4.20

CALCULATED BY: LEG DATE: 06/09/94

REVIEWED BY: Donald Dill DATE 6-9-94

0000001

Quanterra St. Louis
Isotopic Uranium Analysis

Project: 537.01
Batch: 38993

SAMPLE NUMBER	PREP DATE	ALIQUOT (g)	COUNT DATE	COUNT TIME (MIN)	BKGD TIME (MIN)	DET NO.	EFF.	ROI #1 U-238	BKGD	ROI #2 U-235, U-236	BKGD	ROI #3 U-234	BKGD	ROI #4 U-232	BKGD
LCS 38993	6/7/94	2.0000	6/9/94	100	4000	1	0.310	205	87	9	88	220	93	349	84
BLK 38993	6/7/94	2.0000	6/9/94	100	4000	2	0.317		53	1	3	30	75	305	57
5179-001	6/7/94	2.0891	6/9/94	100	4000	3	0.307	12	149	3	112	8	147	22	119
5179-001DUP	6/7/94	2.0208	6/9/94	100	4000	4	0.308	3	58	1	49	8	79	19	111
5179-005	6/7/94	0.0104	6/9/94	100	4000	5	0.311	21	153	7	112	26	102	326	91
5179-011	6/7/94	0.0101	6/9/94	100	4000	6	0.311	20	129	1	130	23	117	321	101
5179-012	6/7/94	0.0101	6/9/94	100	4000	7	0.308	18	80	1	62	21	54	329	69

TRACER pCi added: 10.28
LCS U-238 pCi/matrix: 2.71

CALCULATED BY: LEG DATE: 6/9/94

REVIEWED BY: _____ DATE: 6/9/94

Quanterra Incorporated
13715 Rider Trail North
Earth City, Missouri 63045

314 298-8566 Telephone
314 298-8757 Fax

CASE NARRATIVE

Kerr - McGee Corporation
3301 N.W. 150th Street
Oklahoma City, OK 73134

ATTENTION: Garet E. Van De Steeg

October 3, 1995

PROJECT NUMBER:	578.03
DATE RECEIVED:	May 24, 1994
NUMBER OF SAMPLES:	Four (4)
SAMPLE MATRIX:	Soil

I. Introduction

On May 24, 1994, twelve (12) samples were received at Quanterra Environmental Services at St. Louis from STS Consultants. On September 18, 1995 an additional analysis was requested by Kerr - McGee for the samples listed below. The list of analytical tests performed, as well as receipt and analysis, can be found in the attached report. The samples were labeled as follows:

CLIENT SAMPLE ID	QUANTERRA SAMPLE ID
CD-S156E49N-2-3	9369-001
CD-S156E49N-2-3	9369-001MSD
CD-S156E49N-2-3	9369-001MS
CD-S78E18N-2-3	9369-002
CD-S815E5N-3-4	9369-003
CD-S81E5N-2-3	9369-004

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical tests. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested include: Isotopic Uranium by EPA method U-NAS-NS-3050

III. Quality Control

The QA/QC information can be found immediately following the analytical data. This QA/QC data are used to assess the laboratory's accuracy and precision during the analytical procedure.

IV. Comments/Nonconformances

See the attached correspondence attached in regards to QC analysis. Sample CD-S156E49N-2-3 (9369-001) was chosen for an MS and Dup which is normally performed for Kerr-McGee projects. The lab mistakenly ran an MS and MSD and these QC results are reported.

See the attached Conversation Records in regards to running Alpha Spec. Analysis for 4 samples received from STS in May 1994. Quanterra processes the Alpha Spec analysis by using Region of Interests not Pulse Height as indicated in Mr. Berggreens's letter dated 9/20/95.

ISOTOPIC URANIUM

The comparison of the U^{234}, U^{235} and U^{238} results indicate that the sample is of natural isotopic ratios, not enriched.

I certify that this Case Narrative in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the laboratory manager or his designee, as verified by the following signature.

Reviewed and approved:

Diane W. Mueller
Project Manager

Quanterra September 28, 1995 03:47 pm

Account: 11111 Project: 578.03 Kerr McGee QAS No. 578.03 Rev. 0

Master Sample Login: 9369

Project Manager: D. Mueller

Draft: Final: Entered and Reviewed by: Lacy R Stansfield Review: Diane W Mueller 9.28.95

Sample Header Template:

Sample No. / Client ID / C-Matrix / Date: Collected / Received / Due / Shipper / Rad Category / Rad Sample No.
Comments
Container Type / Analysis / Class / Preservative / Anal. Due Date / Hold Date / Site / (Container Numbers:% Filled)
Data:
9369-001 CD-S156E49N-2-3 Soil 22-MAY-94 12:40 24-MAY-94 09:10 04-OCT-95 IN HOUSE 2 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179516:25)
9369-001DUP CD-S156E49N-2-3 Soil 22-MAY-94 12:40 24-MAY-94 09:10 04-OCT-95 IN HOUSE 2 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179516:25)
9369-001MS CD-S156E49N-2-3 Soil 22-MAY-94 12:40 24-MAY-94 09:10 04-OCT-95 IN HOUSE 2 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179516:25)
9369-002 CD-S78E18N-2-3 Soil 22-MAY-94 16:00 24-MAY-94 09:10 04-OCT-95 IN HOUSE 3 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179517:25)
9369-003 CD-S81E5N-3-4 Soil 22-MAY-94 15:00 24-MAY-94 09:10 04-OCT-95 IN HOUSE 3 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179518:25)
9369-004 CD-S81E5N-2-3 Soil 22-MAY-94 15:00 24-MAY-94 09:10 04-OCT-95 IN HOUSE 3 Screening not Required
1 AN - Amber Glass-500ml RAD/ISOU/04 S COLD 02-OCT-95 20-NOV-94 R19D (179519:25)

3*=Sample has not been rad screened.

ITAS - St. Louis June 07, 1994 02:49 pm
Account: 10952 Project: 537.01 STS Consultants QAS No. 563 Rev. 0
Master Sample Login: 5179

Project Manager: J. Powell

Draft: ~~Final~~ Entered and Reviewed by: V R Shaw, PM Review: [signature] 6/7/94

Sample Header Template: due dates

Sample No. / # / Container Type	Client ID	C-Matrix / Analysis	Date: Collected / Class	Received / Preservative	Due / Anal. Due Date	Shipper / Hold Date	Site	Rad Category / (Container Numbers:% Filled)	Rad Sample No. / Comments / Date:
5179-001	CD-S156E49N-2-3	Soil	22-MAY-94 12:40	24-MAY-94 09:10	14-JUN-94	FED-EX		2	R2312-012
1 AM - Amber Glass-500ml		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79580:100)
1		RAD/ISOTH/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79580:100)
1		RAD/ISOU/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79580:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79580:100)
5179-001DUP	CD-S156E49N-2-3	Soil	22-MAY-94 12:40	24-MAY-94 09:10	14-JUN-94	FED-EX		2	R2312-012
1 AM - Amber Glass-500ml		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79580:100)
5179-002	CD-S156E49N-3-4	Soil	22-MAY-94 12:50	24-MAY-94 09:10	14-JUN-94	FED-EX		2	R2312-011
1 AM - Amber Glass-500ml		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79581:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79581:100)
5179-003	CD-S-S2E25N2-3	Soil	22-MAY-94 13:45	24-MAY-94 09:10	14-JUN-94	FED-EX		3	R2312-010
1 AM - Amber Glass-500ml		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79584:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79584:100)
5179-004	CD-S82E25N-3-4	Soil	22-MAY-94 14:05	24-MAY-94 09:10	14-JUN-94	FED-EX		3	R2312-009
1 AM - Amber Glass-500ml		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79585:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79585:100)
5179-005	CD-S78E18N-2-3	Soil	22-MAY-94 16:00	24-MAY-94 09:10	14-JUN-94	FED-EX		3	R2312-008
1 AM - Amber Glass-500ml		BNA/TCLP/04	S	COLD	09-JUN-94	01-JUN-94	R19D		(79595:100)
1		EXT/TCLP/04	S	COLD	09-JUN-94	05-JUN-94	R19D		(79595:100)
1		HG/TCLP/04	S	COLD	09-JUN-94	22-JUN-94	R19D		(79595:100)
1		ICAP/TCLP/04	S	COLD	09-JUN-94	21-NOV-94	R19D		(79595:100)
1		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79596:100)
1		RAD/ISOTH/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79596:100)
1		RAD/ISOU/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79596:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D		(79596:100)
1 AM - Amber Glass-250ML		CN/9010/04	S	COLD	09-JUN-94	05-JUN-94	R19D		(79594:100)

3*=Sample has not been rad screened.

ITAS - St. Louis June 07, 1994 02:49 pm
Account: 10952 Project: 537.01 STS Consultants QAS No. 563 Rev. 0
Master Sample Login: 5179

Project Manager: J. Powell

Draft: Final: Entered and Reviewed by:_____ PM Review:_____

Sample Header Template: _____

Sample No. / #	Client ID / Container Type	C-Matrix / Analysis	*Date: Collected / Anal. Due Date	Received / Hold Date	Due / Site	Shipper	Rad Category	Rad Sample No. / (Container Numbers:% Filled)
Comments / Date:								
1		FLPT/1010/04	S COLD	09-JUN-94	18-NOV-94 R19D			(79594:100)
1		PAINT/9095/04	S COLD	09-JUN-94	19-JUN-94 R19D			(79594:100)
1		PH/9045/04	S COLD	09-JUN-94	05-JUN-94 R19D			(79594:100)
1		PH/IT/04	S COLD	09-JUN-94	18-NOV-94 R19D			(79594:100)
1		S/9030/04	S COLD	09-JUN-94	29-MAY-94 R19D			(79594:100)
1		TOX/9020/04	S COLD	09-JUN-94	19-JUN-94 R19D			(79594:100)
2	AM - Amber Glass-120ML	TOC/9060/04	S COLD	09-JUN-94	19-JUN-94 R19D			(79590:100 79591:100)
2		VOA/TCLP/04	S COLD	09-JUN-94	08-JUN-94 1098			(79592:100 79593:100)
2		ZERO/TCLP/04	S COLD	09-JUN-94	05-JUN-94 1098			(79592:100 79593:100)
5179-006	CD-[illegible]	Soil	22-MAY-94 14:30	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-007
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79613:90)
1		RAD/SCREEN/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79613:90)
5179-007	CD-[illegible]	Soil	22-MAY-94 14:40	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-006
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79624:90)
1		RAD/SCREEN/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79624:90)
5179-008	CD-[illegible]	Soil	22-MAY-94 16:00	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-005
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79625:90)
1		RAD/SCREEN/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79625:90)
5179-009	CD-[illegible]	Soil	22-MAY-94 16:00	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-004
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79630:90)
1		RAD/SCREEN/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79630:90)
5179-010	CD-[illegible]	Soil	22-MAY-94 15:00	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-003
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79635:90)
1		RAD/SCREEN/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79635:90)
5179-011	CD-[illegible]	Soil	22-MAY-94 15:00	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-002
1	AM - Amber Glass-500ml	RAD/GAMMA/04	S COLD	09-JUN-94	20-NOV-94 R19D			(79636:90)

3*=Sample has not been rad screened.

ITAS - St. Louis June 07, 1994 02:49 pm
Account: 10952 Project: 537.01 STS Consultants QAS No. 563 Rev. 0
Master Sample Login: 5179

Project Manager: J. Powell

Draft: Final: Entered and Reviewed by:_____ PM Review:_____

Sample Header Template: _____

Sample No.	Client ID	C-Matrix	Date: Collected	Received	Due	Shipper	Rad Category	Rad Sample No.
# Container Type	Comments	Analysis	Class	Preservative	Anal. Due Date	Hold Date	Site	(Container Numbers:X Filled)
Data:								
1		RAD/ISOTH/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79636:90)
1		RAD/ISOU/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79636:90)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79636:90)
5179-012	CD-SB18SH-2-3	Soil	22-MAY-94 15:00	24-MAY-94 09:10	14-JUN-94	FED-EX	3	R2312-001
1	All - Amber Glass-500ml	BNA/TCLP/04	S	COLD	09-JUN-94	01-JUN-94	R19D	(79644:100)
1		EXT/TCLP/04	S	COLD	09-JUN-94	05-JUN-94	R19D	(79644:100)
1		HG/TCLP/04	S	COLD	09-JUN-94	22-JUN-94	R19D	(79644:100)
1		ICAP/TCLP/04	S	COLD	09-JUN-94	21-NOV-94	R19D	(79644:100)
1		RAD/GAMMA/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79643:100)
1		RAD/ISOTH/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79643:100)
1		RAD/ISOU/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79643:100)
1		RAD/SCREEN/04	S	COLD	09-JUN-94	20-NOV-94	R19D	(79643:100)
1	All - Amber Glass-250ML	CN/9010/04	S	COLD	09-JUN-94	05-JUN-94	R19D	(79645:100)
1		FLPT/1010/04	S	COLD	09-JUN-94	18-NOV-94	R19D	(79645:100)
1		PAINT/9095/04	S	COLD	09-JUN-94	19-JUN-94	R19D	(79645:100)
1		PH/9045/04	S	COLD	09-JUN-94	05-JUN-94	R19D	(79645:100)
1		PH/IT/04	S	COLD	09-JUN-94	18-NOV-94	R19D	(79645:100)
1		S/9030/04	S	COLD	09-JUN-94	29-MAY-94	R19D	(79645:100)
1		TOX/9020/04	S	COLD	09-JUN-94	19-JUN-94	R19D	(79645:100)
2	All - Amber Glass-120ML	TOC/9060/04	S	COLD	09-JUN-94	19-JUN-94	R19D	(79648:100 79651:100)
2		VOA/TCLP/04	S	COLD	09-JUN-94	08-JUN-94	109B	(79646:100 79647:100)
2		ZERO/TCLP/04	S	COLD	09-JUN-94	05-JUN-94	109B	(79646:100 79647:100)

3*=Sample has not been rad screened.

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S156E49N-2-3	9369-001	Uranium-238	09/27/95	10/03/95	1.62	PCI/G	0.55	0.14
CD-S156E49N-2-3	9369-001	Uranium-235/236	09/27/95	10/03/95	0.08	PCI/G	0.12	0.16
CD-S156E49N-2-3	9369-001	Uranium-234	09/27/95	10/03/95	1.66	PCI/G	0.56	0.12

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S156E49N-2-3	9369-001MS	Uranium-238	09/27/95	10/03/95	144	%REC		
CD-S156E49N-2-3	9369-001MS	Uranium-234	09/27/95	10/03/95	157	%REC		

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra
Environmental Services

Category: Isotopic Uranium
Method: MAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S156E49N-2-3	9369-001MSD	Uranium-238	09/27/95	10/03/95	124	%REC		
CD-S156E49N-2-3	9369-001MSD	Uranium-234	09/27/95	10/03/95	128	%REC		

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra
Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S78E18N-2-3	9369-002	Uranium-238	09/27/95	10/03/95	32.0	PCI/G	6.8	0.2
CD-S78E18N-2-3	9369-002	Uranium-235/236	09/27/95	10/03/95	3.25	PCI/G	1.08	0.27
CD-S78E18N-2-3	9369-002	Uranium-234	09/27/95	10/03/95	30.0	PCI/G	6.4	0.2

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S81E5N-3-4	9369-003	Uranium-238	09/27/95	10/03/95	82.8	PCI/G	17.2	0.2
CD-S81E5N-3-4	9369-003	Uranium-235/236	09/27/95	10/03/95	10.4	PCI/G	2.6	0.2
CD-S81E5N-3-4	9369-003	Uranium-234	09/27/95	10/03/95	89.6	PCI/G	18.6	0.2

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: 05/22/94
Date Received: 05/24/94

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
CD-S81E5N-2-3	9369-004	Uranium-238	09/27/95	10/03/95	52.4	PCI/G	11.1	0.2
CD-S81E5N-2-3	9369-004	Uranium-235/236	09/27/95	10/03/95	7.47	PCI/G	2.04	0.31
CD-S81E5N-2-3	9369-004	Uranium-234	09/27/95	10/03/95	51.1	PCI/G	10.8	0.3

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: N/A
Date Received: N/A

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
NA	QCBLK78772-1	Uranium-238	09/27/95	10/03/95	-0.0007	PCI/G	0.0014	0.0959
NA	QCBLK78772-1	Uranium-235/236	09/27/95	10/03/95	0.10	PCI/G	0.12	0.14
NA	QCBLK78772-1	Uranium-234	09/27/95	10/03/95	-0.001	PCI/G	0.002	0.105

Kerr McGee
3301 N.W. 150th Street
Oklahoma City, OK 73134

Project: 578.03

Quanterra Environmental Services

Category: Isotopic Uranium
Method: NAS-NS-3050
Matrix: Soil

Report Date: 10/03/95
Date Sampled: N/A
Date Received: N/A

Client ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA
NA	QCLCS78772-1	Uranium-238	09/27/95	10/03/95	146	%REC		
NA	QCLCS78772-1	Uranium-234	09/27/95	10/03/95	126	%REC		

Quanterra
Environmental
Services

Alpha Spectroscopy

Uranium

Quanterra
Environmental
Services

DATA REPORTS

0000001

ALSPDR1.DOC

Quanterra
Environmental
Services

DATA REPORTS AND CHANNEL BY CHANNEL REPORT

ALSPDR2.DOC

0000092

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 08:59:44

Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-001_UU.CNF

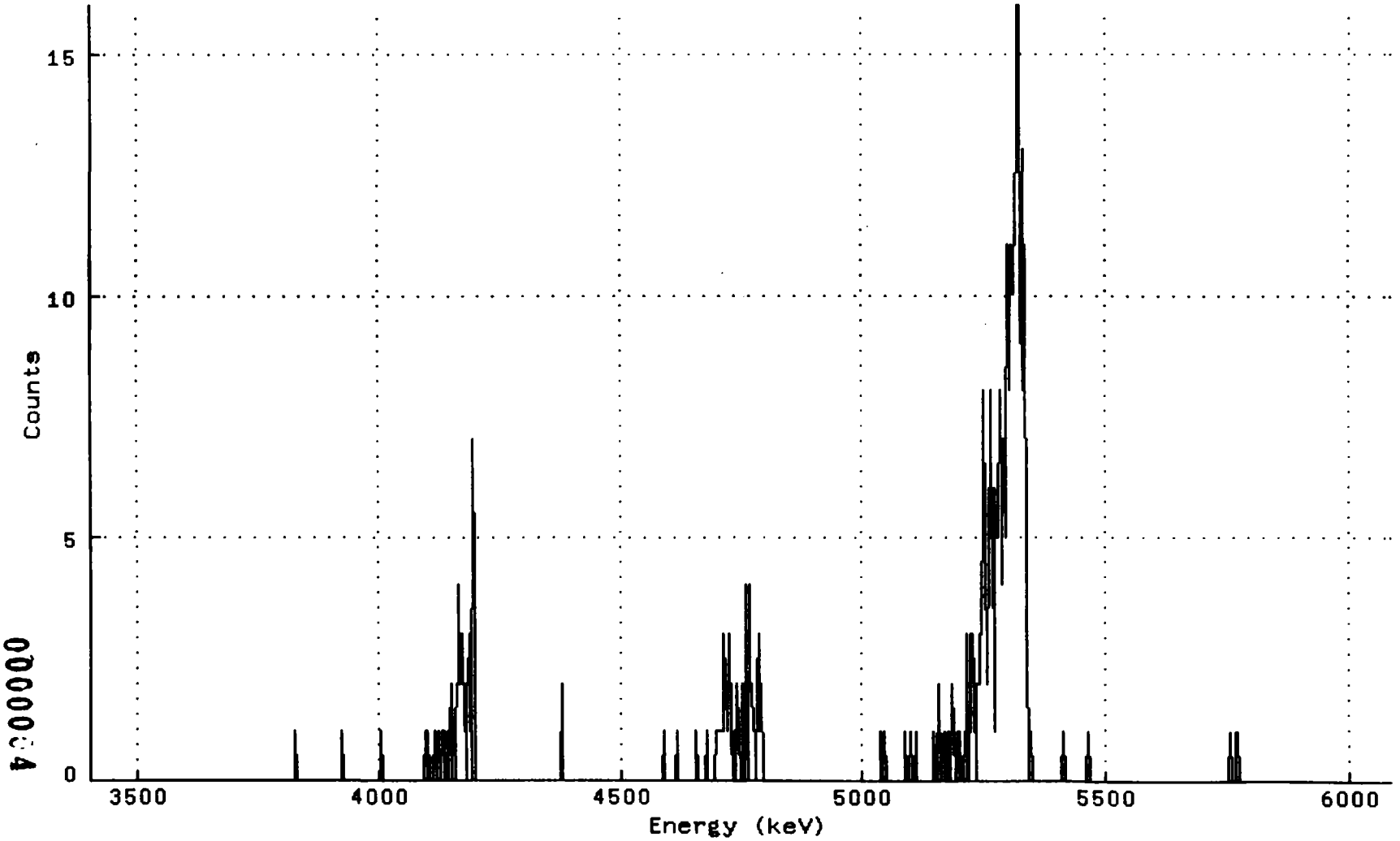
RELEASE/BATCH #	78772	SAMPLE ID:	9369-001
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.026E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	005
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	31.3%
ELAPSED LIVE TIME:	5989.	RECOVERY:	42.25%
TRACER ID:	U-232	TRACER FWHM (kev):	36.60
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_005_29SEP95		

NUCLIDE ACTIVITY SUMMARY

NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	296.75	0.25	99.8	9.884E+00	1.525E+00	1.677E-01	1.290E-01
U-234	4761.5	49.95	0.05	99.8	1.664E+00	5.624E-01	1.249E-01	1.076E-01
U-235	4385.5	1.93	0.07	80.9	7.910E-02	1.172E-01	1.637E-01	1.375E-01
U-238	4184.4	48.88	0.12	100.2	1.621E+00	5.524E-01	1.444E-01	1.171E-01

*** POSITIVE ***

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-001_UU.CNF;1
Title : 005
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.39533E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-001 Energy Slope : 2.63077E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : -8.07213E-06



Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-001_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	1	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	1
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	1	0	1	0	0	0
273:	0	1	0	0	1	0	0	1
281:	1	0	0	1	0	1	2	0
289:	1	0	1	2	2	4	2	3
297:	2	2	0	2	2	3	2	0
305:	7	4	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0
369:	0	0	0	0	0	2	0	0
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0

433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	1	0	0
457:	0	0	0	0	0	0	0	1
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	1
481:	0	0	0	0	0	0	0	1
489:	0	0	0	0	0	0	1	1
497:	1	1	1	1	1	3	2	1
505:	1	3	1	1	0	1	0	2
513:	1	1	0	0	2	0	4	1
521:	0	4	2	2	1	1	0	2
529:	3	1	2	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	1	0	1	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	1	0	0	0	1
649:	0	0	0	1	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	1	0	0	0	2	0	0
673:	0	0	1	0	0	1	0	2
681:	2	1	0	0	1	0	1	0
689:	0	0	1	0	3	0	3	1
697:	3	2	0	2	2	2	3	3
705:	6	8	5	2	3	4	8	5
713:	6	1	6	5	6	5	8	6
721:	4	7	5	6	11	8	10	11
729:	10	10	12	13	16	16	9	13
737:	8	11	3	3	0	1	1	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	1
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	1	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	1	0	0	0	0	1	1
905:	0	0	0	0	0	0	0	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 08:59:02.24

Detector ID: 5 Acquisition Start: 3-OCT-1995 06:49:30.05
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-001
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4170.92	49	0	32.36	295.08	262	64	8.18E-03	14.3	
2	0	4378.11	2	0	2.63	374.00	363	58	3.34E-04	70.7	
3	0	4744.73	50	0	73.64	513.74	482	64	8.35E-03	14.1	
4	0	5293.43	297	0	36.60	723.10	690	64	4.96E-02	5.8	

Background Counts Within Peak Regions Generated: 3-OCT-1995 08:59:13.10

Acquisition Start: 29-SEP-1995 11:42:13.05
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4158.51	5	0	3.95	293.50	262	64	2.09E-05	44.7	
2	0	4419.07	3	0	53.80	391.50	363	58	1.25E-05	57.7	
3	0	4742.21	2	0	83.39	513.50	482	64	8.35E-06	70.7	
4	0	5290.00	10	0	0.00	721.50	690	64	4.17E-05	31.6	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 08:58:18

Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-001MS_UU.CNF

RELEASE/BATCH #	78772	SAMPLE ID:	9369-001MS
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.021E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	006
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	30.4%
ELAPSED LIVE TIME:	5989.	RECOVERY:	33.44%
TRACER ID:	U-232	TRACER FWHM (kev):	69.99
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_006_29SEP95		

NUCLIDE ACTIVITY SUMMARY

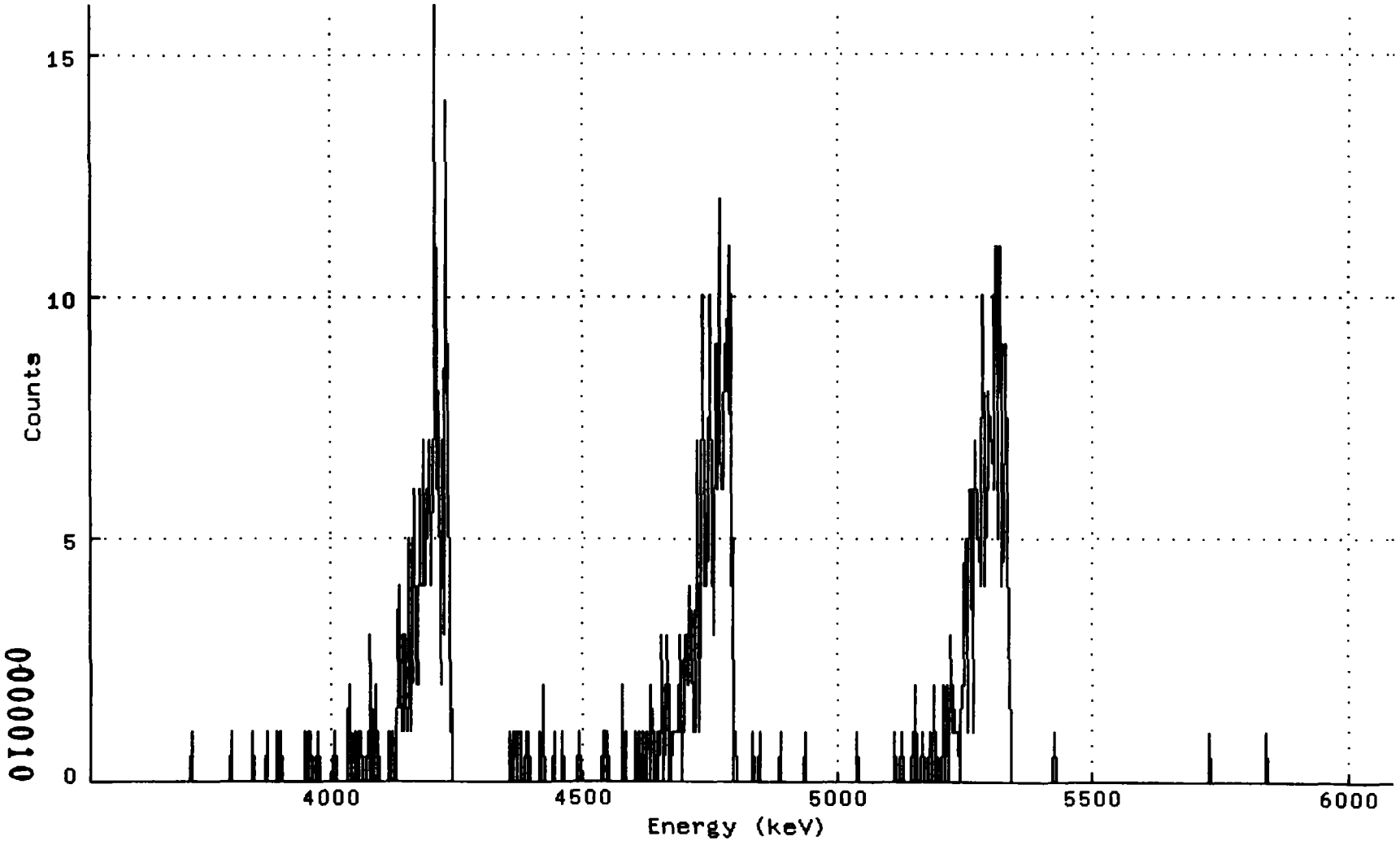
NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	227.80	0.20	99.8	9.934E+00	1.655E+00	2.089E-01	1.635E-01
U-234	4761.5	229.88	0.12	99.8	1.002E+01	2.358E+00	1.899E-01	1.540E-01
U-235	4385.5	14.93	0.07	80.9	8.029E-01	4.451E-01	2.143E-01	1.800E-01
U-238	4184.4	213.80	0.20	100.2	9.283E+00	2.210E+00	2.080E-01	1.628E-01

*** POSITIVE ***

	MS spike	% Rec
^{234}U	5.32 pCi/s	157%
^{238}U	↓	144%

0000039

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-001MS_UU.CNF;1
Title : 006
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.51785E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-001MS Energy Slope : 2.38533E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 1.14892E-04



Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-001MS_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	1	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	1	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	1
137:	0	0	0	0	0	0	0	0
145:	0	0	1	0	0	0	0	0
153:	0	0	0	1	0	0	1	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	1	0	1	0	1	0
185:	0	0	0	0	1	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	1	1	0	0	0	0	0
209:	0	0	0	0	0	1	2	0
217:	0	0	0	1	0	0	1	1
225:	0	0	0	0	0	1	0	3
233:	0	0	0	2	0	1	0	0
241:	0	0	0	0	0	0	1	0
249:	1	1	0	1	0	3	4	2
257:	1	1	3	3	2	1	2	5
265:	1	3	4	6	2	2	2	6
273:	4	4	4	7	4	6	5	7
281:	4	5	6	8	16	6	7	8
289:	2	6	7	3	14	8	9	1
297:	3	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	1	0	1	0	1	0	1	1
353:	1	0	0	0	0	1	0	1
361:	0	0	0	0	0	0	0	0
369:	1	0	2	1	0	0	0	0
377:	0	0	0	1	0	0	0	0
385:	0	0	1	0	0	0	0	0
393:	0	0	0	0	0	0	0	1
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	1	0	1	0	1	0
425:	0	0	0	0	0	0	0	0

433:	0	0	2	0	1	0	0	0
441:	0	0	0	0	1	0	1	0
449:	0	1	0	0	1	0	0	0
457:	2	1	1	0	0	1	0	1
465:	1	3	0	1	1	3	0	2
473:	0	1	1	1	1	1	1	3
481:	2	0	2	2	3	2	2	4
489:	3	1	2	1	6	7	1	4
497:	4	10	4	7	4	5	5	10
505:	4	6	3	9	7	6	12	7
513:	6	6	7	9	8	8	11	4
521:	10	0	1	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	1	0	0	0	0	1	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	1	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	1	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	1	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	1	0
649:	0	0	0	1	1	0	0	0
657:	0	0	0	0	1	0	2	0
665:	0	0	0	1	1	0	0	0
673:	0	1	0	0	2	0	1	0
681:	0	0	0	1	2	0	1	2
689:	0	3	1	2	1	1	1	1
697:	0	1	2	2	4	5	1	4
705:	6	6	1	5	7	5	5	5
713:	4	5	10	6	4	6	6	8
721:	7	7	6	9	11	7	5	11
729:	7	4	5	8	9	6	2	1
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	1	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	1
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 08:57:40.65

Detector ID: 6 Acquisition Start: 3-OCT-1995 06:49:30.06
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-001MS
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4191.84	214	0	26.53	278.81	235	69	3.57E-02	6.8	
2	0	4402.15	15	0	3.50	364.33	343	62	2.50E-03	25.8	
3	0	4749.36	230	0	67.73	504.05	469	67	3.84E-02	6.6	
4	0	5287.91	228	0	69.99	717.28	685	66	3.81E-02	6.6	

Background Counts Within Peak Regions Generated: 3-OCT-1995 08:57:52.12

Acquisition Start: 29-SEP-1995 11:42:13.06
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4168.03	8	0	2.39	269.00	235	69	3.34E-05	35.4	
2	0	4425.14	3	0	71.62	373.50	343	62	1.25E-05	57.7	
3	0	4744.71	5	0	155.17	502.00	469	67	2.09E-05	44.7	
4	0	5289.11	8	0	2.39	717.50	685	66	3.34E-05	35.4	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 08:56:59

Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-001MSD_UU.CNF

RELEASE/BATCH #	78772	SAMPLE ID:	9369-001MSD
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.010E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	007
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	30.5%
ELAPSED LIVE TIME:	5989.	RECOVERY:	44.07%
TRACER ID:	U-232	TRACER FWHM (kev):	73.88
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_007_29SEP95		

NUCLIDE ACTIVITY SUMMARY

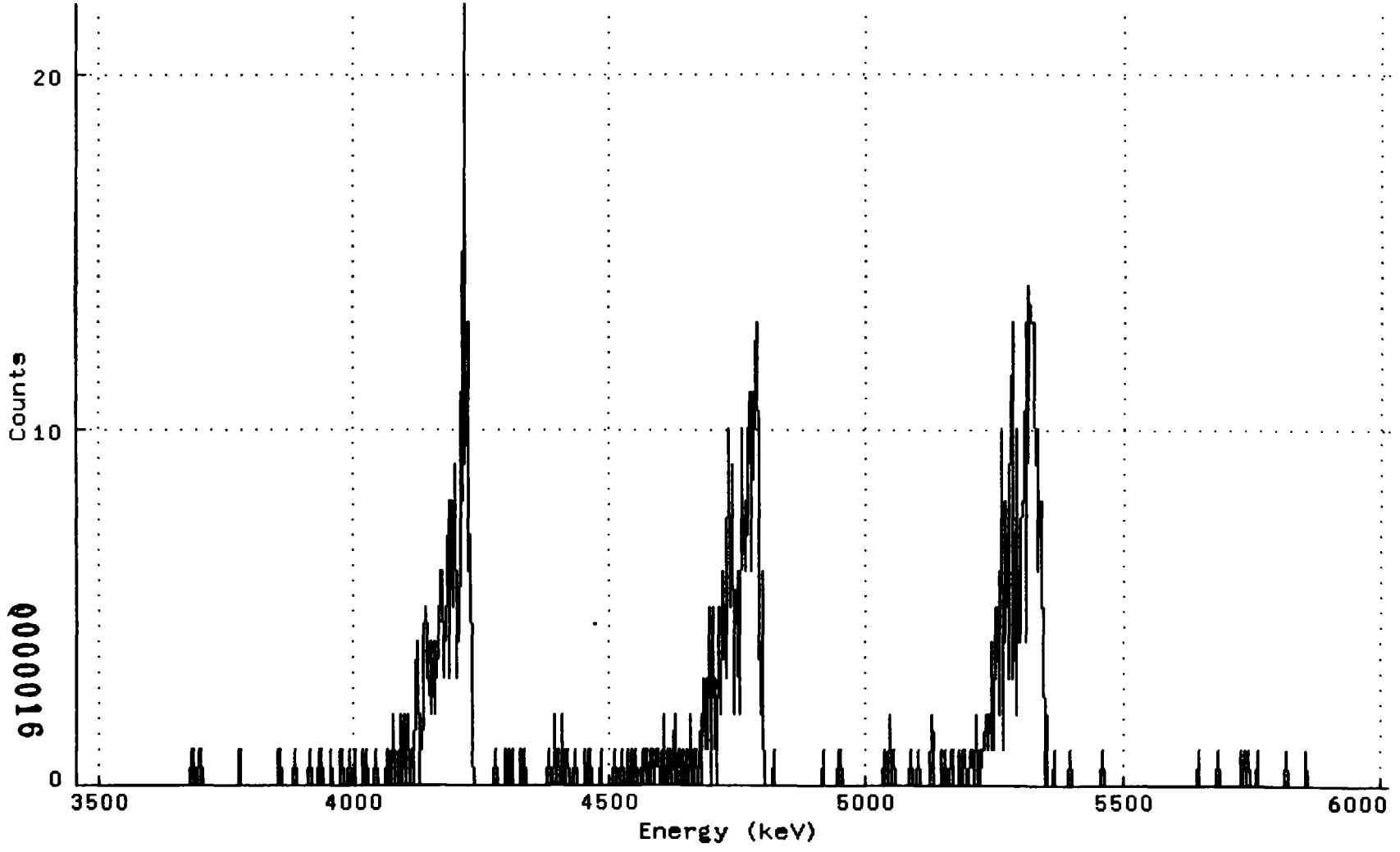
NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	301.28	1.72	99.8	1.004E+01	1.543E+00	2.939E-01	1.921E-01
U-234	4761.5	256.50	1.50	99.8	8.550E+00	1.903E+00	2.802E-01	1.853E-01
U-235	4385.5	13.48	1.52	80.9	5.541E-01	3.348E-01	3.476E-01	2.295E-01
U-238	4184.4	249.70	2.30	100.2	8.288E+00	1.853E+00	3.240E-01	2.070E-01

*** POSITIVE ***

	MS spike	%Rec
^{234}U	5.38 pCi/g	128%
^{238}U	↓	124%

0000015

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-001MSD_UU.CNF;1
Title : 007
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.44659E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-001MSD Energy Slope : 2.42252E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 7.87397E-05



Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-001MSD_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	1
97:	0	1	0	0	0	1	0	1
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	1	1	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	1	1	0
169:	0	0	0	0	0	0	0	0
177:	0	0	1	0	0	0	0	0
185:	0	0	0	0	0	0	1	0
193:	0	0	0	0	0	1	0	1
201:	0	0	0	0	0	0	0	1
209:	0	0	0	0	0	0	0	1
217:	1	0	0	0	0	0	1	0
225:	0	0	1	0	0	0	0	0
233:	0	1	0	0	1	0	0	0
241:	0	0	0	1	0	0	0	0
249:	0	0	0	0	1	0	0	0
257:	2	2	0	0	0	0	2	0
265:	0	1	2	0	2	2	0	1
273:	1	0	3	3	4	0	1	1
281:	2	4	5	4	3	3	2	4
289:	3	2	4	3	4	4	6	5
297:	6	3	5	4	6	8	3	8
305:	5	5	9	3	6	4	7	11
313:	8	22	9	10	13	6	7	2
321:	1	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	1	0	0	0	0	0	0
345:	0	1	0	1	0	0	1	0
353:	0	0	0	0	0	1	0	0
361:	1	0	0	0	0	0	0	0
369:	0	0	0	0	0	0	0	0
377:	0	0	0	1	0	0	0	1
385:	2	0	1	1	0	0	2	0
393:	1	0	1	0	0	0	0	0
401:	1	0	0	0	0	0	0	0
409:	1	0	0	1	1	0	0	0
417:	0	0	0	0	1	0	0	0
425:	0	0	0	0	0	0	0	1

433:	0	0	0	0	0	1	0	0
441:	0	0	1	0	0	1	0	1
449:	1	0	0	0	0	1	0	1
457:	1	0	0	1	0	1	0	1
465:	1	1	0	0	0	2	0	0
473:	1	0	1	0	0	1	2	0
481:	0	1	1	0	0	1	0	1
489:	1	0	1	2	0	0	1	1
497:	0	0	1	2	0	3	1	2
505:	1	5	0	0	5	1	3	0
513:	5	3	2	5	6	4	3	5
521:	10	5	6	9	2	4	5	6
529:	4	2	10	8	7	6	10	7
537:	11	11	6	11	10	12	13	8
545:	5	2	6	2	0	0	0	0
553:	0	0	0	1	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	1	0	0	0	0	0	0
601:	0	0	0	0	0	1	0	1
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	1	0	0	0	0	2	0	0
649:	1	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	1	0	0	0	0
673:	0	0	0	0	0	2	1	0
681:	0	0	0	0	0	1	0	0
689:	1	0	0	0	1	1	0	0
697:	0	0	1	0	0	1	1	0
705:	0	0	1	1	1	0	0	2
713:	0	1	0	1	1	1	2	1
721:	2	2	1	4	1	5	3	4
729:	6	2	10	1	8	4	7	3
737:	8	10	13	3	4	10	2	6
745:	4	7	8	8	13	4	14	13
753:	13	13	13	11	9	10	6	8
761:	8	5	5	0	2	0	0	0
769:	0	0	1	0	0	0	0	0
777:	0	0	0	0	0	0	1	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	1
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	1	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	1
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0

913:	0	1	0	1	0	0	1	0
921:	0	0	0	0	0	1	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	1	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	1	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 08:56:15.71

Detector ID: 7 Acquisition Start: 3-OCT-1995 06:49:30.07
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-001MSD
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4184.78	252	0	9.86	301.76	261	68	4.21E-02	6.3	
2	0	4417.43	15	0	18.09	395.67	369	61	2.50E-03	25.8	
3	0	4751.90	258	0	58.41	529.70	494	67	4.31E-02	6.2	
4	0	5295.77	303	0	73.88	745.27	710	66	5.06E-02	5.7	

Background Counts Within Peak Regions Generated: 3-OCT-1995 08:56:25.80

Acquisition Start: 29-SEP-1995 11:42:13.07
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4162.94	92	0	136.20	294.50	261	68	3.84E-04	10.4	
2	0	4424.33	61	0	137.36	399.00	369	61	2.55E-04	12.8	
3	0	4746.09	60	0	0.00	527.00	494	67	2.50E-04	12.9	
4	0	5291.81	69	0	149.82	742.50	710	66	2.88E-04	12.0	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 09:01:47

****

Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-002_UU.CNF

****

RELEASE/BATCH #	78772	SAMPLE ID:	9369-002
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.025E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	008
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	33.1%
ELAPSED LIVE TIME:	5989.	RECOVERY:	28.77%
TRACER ID:	U-232	TRACER FWHM (kev):	64.23
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_008_29SEP95		

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NUCLIDE ACTIVITY SUMMARY

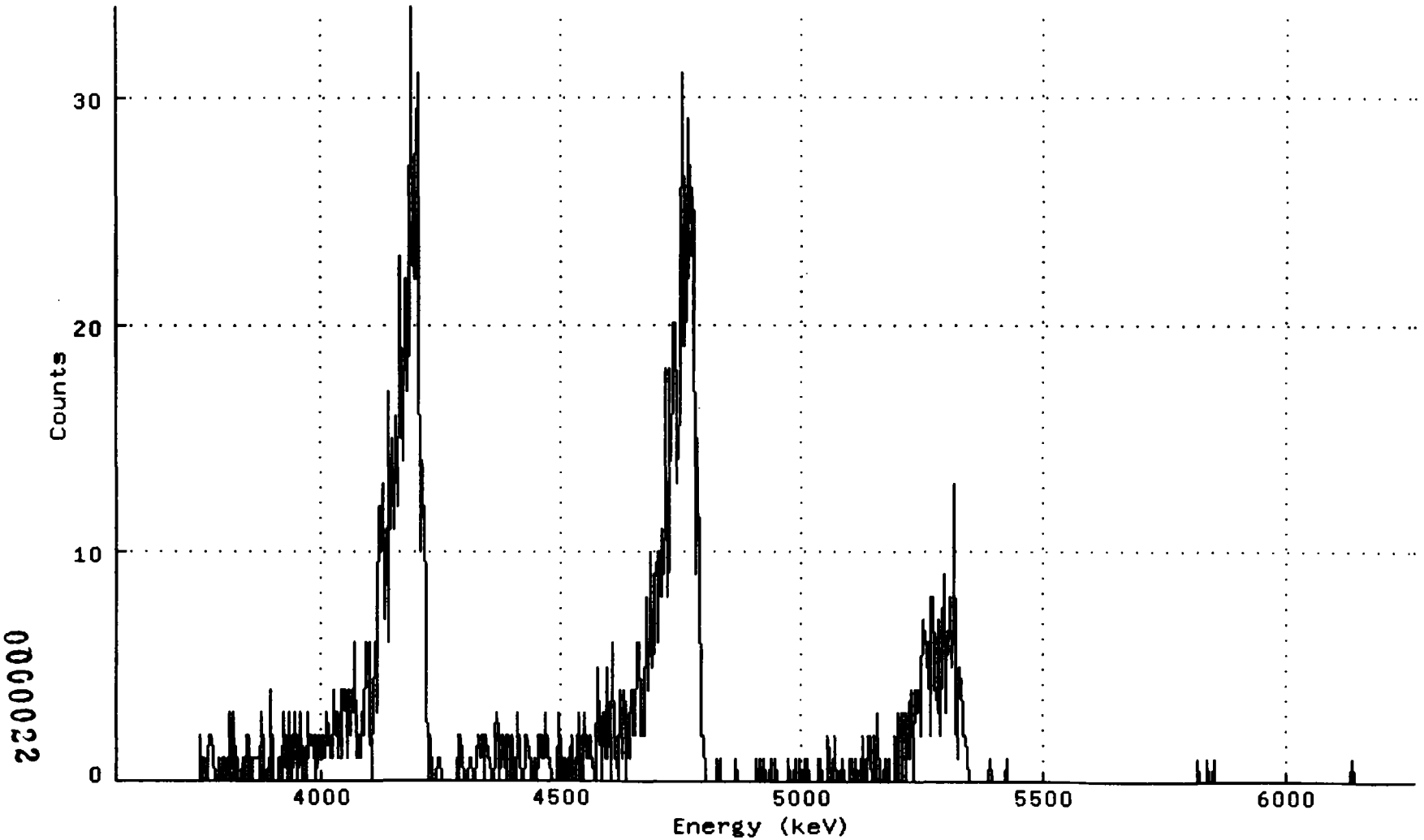
NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	213.58	0.42	99.8	9.900E+00	1.685E+00	2.661E-01	1.959E-01
U-234	4761.5	646.88	0.12	99.8	2.998E+01	6.387E+00	2.018E-01	1.637E-01
U-235	4385.5	56.83	0.17	80.9	3.249E+00	1.077E+00	2.662E-01	2.106E-01
U-238	4184.4	693.88	0.12	100.2	3.203E+01	6.790E+00	2.010E-01	1.630E-01

****

*** POSITIVE ***

0000021

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-002_UU.CNF;1
Title : 008
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.56429E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-002 Energy Slope : 2.59108E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 4.28379E-05



2200022

Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-002_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	2	0
73:	1	1	0	0	1	2	2	2
81:	1	0	0	0	0	1	0	1
89:	0	1	0	0	1	0	3	1
97:	0	3	0	1	0	0	0	0
105:	1	0	0	2	2	0	1	0
113:	1	1	1	1	1	1	0	3
121:	1	0	0	0	0	1	0	4
129:	0	0	0	0	0	1	1	0
137:	0	3	1	1	0	3	1	0
145:	1	1	3	1	0	1	1	3
153:	0	0	0	0	3	1	2	2
161:	2	1	2	0	1	2	2	1
169:	2	1	1	2	3	2	1	1
177:	1	3	4	2	3	1	1	1
185:	4	4	4	2	1	4	2	2
193:	4	3	6	1	2	1	1	3
201:	2	2	6	5	5	6	3	0
209:	4	3	6	3	7	12	12	10
217:	13	7	10	11	6	17	11	13
225:	15	11	16	14	12	18	23	15
233:	16	14	22	19	17	20	34	30
241:	23	22	27	28	31	22	10	13
249:	14	10	9	5	0	2	2	0
257:	0	0	0	1	1	1	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	2	0	2	1	1
281:	0	0	0	0	1	1	1	0
289:	0	0	1	1	2	1	1	2
297:	0	2	2	1	1	1	0	0
305:	0	1	2	3	2	0	1	1
313:	2	1	0	2	2	1	0	2
321:	0	0	0	2	3	1	0	0
329:	0	1	2	2	1	1	0	0
337:	1	1	0	1	2	2	1	2
345:	1	2	3	1	1	1	0	0
353:	0	0	0	0	3	1	0	1
361:	1	0	0	1	0	1	2	0
369:	0	0	1	1	3	0	0	2
377:	0	3	1	1	1	2	1	1
385:	0	1	0	5	2	3	0	3
393:	2	1	5	1	3	0	1	6
401:	1	1	1	0	0	4	1	1
409:	4	3	0	2	1	2	4	2
417:	4	2	6	5	6	3	2	2
425:	4	2	8	4	7	10	5	6

433:	9	9	10	6	10	8	11	9
441:	12	18	8	10	18	14	18	20
449:	20	16	13	15	16	21	31	22
457:	19	21	29	22	27	25	23	25
465:	9	12	15	8	4	2	2	0
473:	0	0	0	0	0	0	0	0
481:	0	1	0	1	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	1	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	1	0	0	1	0	0	1	0
521:	0	0	0	1	0	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	1	0	0	0	0	1	0
545:	0	0	1	0	0	0	1	0
553:	1	0	0	0	0	0	0	0
561:	0	1	1	0	0	0	0	0
569:	2	1	0	0	0	2	1	0
577:	0	0	0	1	1	0	0	0
585:	0	0	1	1	0	0	1	0
593:	0	0	0	2	0	0	0	0
601:	2	2	1	0	0	2	0	3
609:	2	0	0	0	0	1	1	0
617:	1	0	0	0	0	2	0	3
625:	0	0	0	3	3	3	0	2
633:	1	3	4	0	1	4	3	4
641:	4	2	4	7	6	6	5	6
649:	2	8	8	5	4	4	3	7
657:	2	6	6	9	3	5	6	7
665:	8	5	7	13	3	1	3	5
673:	4	3	2	2	1	1	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	1	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	1	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	1	0	0	0	0	0	0	1
865:	0	0	0	0	1	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	1
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 09:00:46.49

Detector ID: 8 Acquisition Start: 3-OCT-1995 06:49:30.08
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-002
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4169.66	694	0	42.74	232.74	200	64	1.16E-01	3.8	
2	0	4423.05	57	0	132.79	329.63	302	58	9.52E-03	13.2	
3	0	4740.89	647	0	59.62	450.74	421	63	1.08E-01	3.9	
4	0	5279.12	214	0	64.23	654.73	627	63	3.57E-02	6.8	

Background Counts Within Peak Regions Generated: 3-OCT-1995 09:01:03.06

Acquisition Start: 29-SEP-1995 11:42:13.08
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4169.99	5	0	142.48	231.50	200	64	2.09E-05	44.7	
2	0	4428.78	7	0	0.00	330.50	302	58	2.92E-05	37.8	
3	0	4747.50	5	0	137.30	452.00	421	63	2.09E-05	44.7	
4	0	5290.70	17	0	2.59	658.00	627	63	7.10E-05	24.3	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 09:04:01

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Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-003_UU.CNF

****

RELEASE/BATCH #	78772	SAMPLE ID:	9369-003
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.043E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	009
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	31.1%
ELAPSED LIVE TIME:	5989.	RECOVERY:	28.10%
TRACER ID:	U-232	TRACER FWHM (kev):	92.82
LAMBDA VALUE:	1000.	ROI TYPE:	EXPANDED
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_009_29SEP95		

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NUCLIDE ACTIVITY SUMMARY

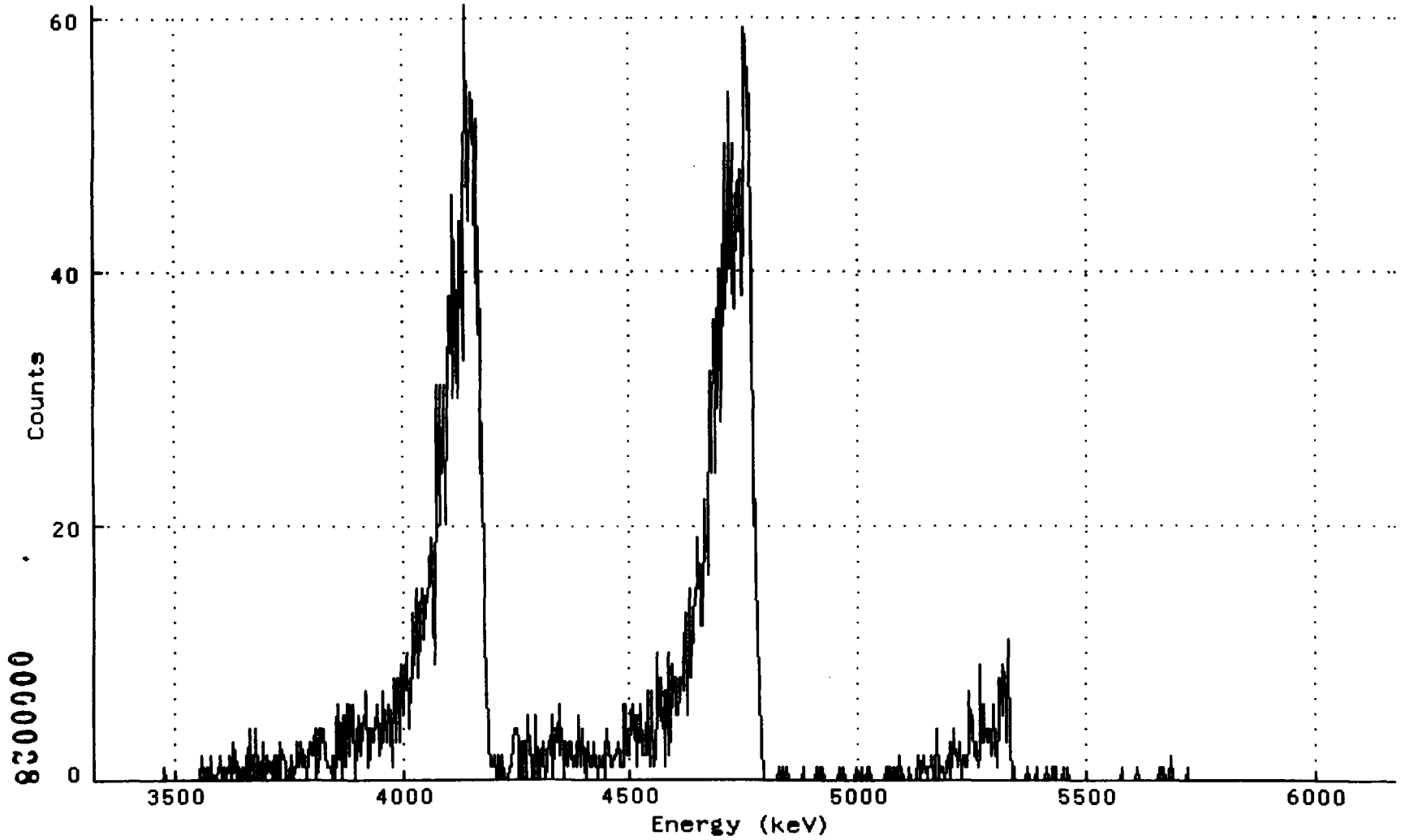
NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	195.75	0.25	99.8	9.724E+00	1.701E+00	2.501E-01	1.924E-01
U-234	4761.5	1803.85	0.15	99.8	8.961E+01	1.857E+01	2.241E-01	1.794E-01
U-235	4385.5	169.00	0.00	80.9	1.036E+01	2.629E+00	1.661E-01	1.661E-01
U-238	4184.4	1672.95	0.05	100.2	8.275E+01	1.719E+01	1.855E-01	1.598E-01

****

*** POSITIVE ***

0000027

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-003_UU.CNF;1
Title : 009
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.31227E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-003 Energy Slope : 2.90198E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : -1.10080E-04



Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-003_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	1
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	2	0	1	0	1
89:	0	0	2	1	0	0	0	0
97:	1	1	2	0	1	1	0	1
105:	1	2	0	1	3	2	1	0
113:	1	0	0	1	0	0	2	1
121:	4	0	2	0	0	4	0	0
129:	0	0	3	1	0	1	2	1
137:	1	0	1	2	2	0	1	0
145:	3	2	2	1	0	0	0	0
153:	2	0	0	1	1	3	1	3
161:	2	1	2	0	0	2	3	3
169:	2	3	4	0	1	2	4	4
177:	3	4	2	1	1	1	1	0
185:	2	0	2	4	6	3	3	0
193:	5	1	2	6	2	6	4	3
201:	6	0	3	3	5	2	4	4
209:	5	4	7	1	2	4	4	3
217:	4	4	6	3	2	3	3	7
225:	4	4	3	6	5	4	1	8
233:	7	3	8	5	3	9	7	5
241:	9	8	10	4	8	8	13	9
249:	11	15	8	12	13	15	14	11
257:	14	15	14	16	19	12	13	9
265:	28	31	25	20	31	24	31	29
273:	20	30	38	35	37	30	46	39
281:	38	32	30	44	42	44	33	41
289:	61	49	44	48	54	53	52	48
297:	39	52	35	37	24	28	12	7
305:	8	3	1	1	1	2	2	0
313:	0	2	0	1	2	0	0	0
321:	0	1	1	1	3	4	4	4
329:	3	0	0	3	0	3	0	1
337:	5	2	2	0	0	3	5	0
345:	0	2	2	3	2	0	1	2
353:	3	2	5	0	3	3	4	3
361:	6	2	4	2	0	3	1	1
369:	3	3	2	1	2	2	1	5
377:	1	1	4	1	1	0	3	2
385:	1	1	1	3	1	2	0	2
393:	1	1	2	0	2	4	2	3
401:	1	1	1	2	2	2	3	2
409:	1	1	1	6	6	2	3	2
417:	5	6	4	5	1	5	3	3
425:	6	2	2	2	2	7	3	1

433:	7	5	1	2	6	10	5	8
441:	5	4	7	1	7	2	10	3
449:	8	9	7	8	5	5	7	8
457:	8	7	10	13	5	11	15	8
465:	13	12	15	15	19	15	16	12
473:	12	22	17	19	18	16	32	24
481:	26	36	36	24	34	40	28	29
489:	42	37	50	39	41	54	42	50
497:	39	37	46	45	47	46	48	38
505:	44	59	58	51	56	52	41	41
513:	20	22	15	13	6	4	3	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	1	0	0	1	0
537:	0	1	0	0	0	0	0	0
545:	0	0	0	0	0	0	1	0
553:	0	0	0	0	0	0	0	0
561:	1	0	0	1	0	1	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	1	1	0	0	1	0
585:	0	0	0	0	0	0	0	0
593:	1	0	0	0	1	0	0	0
601:	0	1	0	1	0	0	0	0
609:	0	0	0	0	0	0	0	1
617:	0	1	1	0	0	0	1	0
625:	1	0	2	0	1	0	0	0
633:	0	0	1	0	0	0	0	0
641:	0	2	1	0	1	2	1	1
649:	0	1	1	1	2	0	0	0
657:	4	0	1	1	1	1	0	1
665:	1	2	0	3	1	4	3	2
673:	2	1	3	0	1	2	1	2
681:	1	3	7	4	5	4	2	3
689:	2	1	2	9	3	6	3	4
697:	4	3	4	2	2	6	2	4
705:	1	5	8	7	5	9	8	5
713:	3	11	2	3	0	1	0	0
721:	0	0	0	0	0	0	0	0
729:	1	0	0	0	0	0	0	1
737:	0	0	0	0	0	0	0	1
745:	0	0	0	0	1	1	1	0
753:	0	0	0	0	1	0	0	0
761:	1	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	1	0	0	0	0
809:	0	0	0	0	0	0	0	1
817:	1	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	1	0	1	0	1	0	0
841:	0	0	2	2	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	1	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 09:02:58.52

Detector ID: 9 Acquisition Start: 3-OCT-1995 06:49:30.09
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-003
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4125.26	1673	0	100.45	283.19	251	82	2.79E-01	2.4	
2	0	4413.83	169	0	192.00	385.22	345	77	2.82E-02	7.7	
3	0	4716.55	1804	0	97.56	493.13	456	83	3.01E-01	2.4	
4	0	5272.46	196	0	92.82	693.72	651	85	3.27E-02	7.1	

Background Counts Within Peak Regions Generated: 3-OCT-1995 09:03:11.07

Acquisition Start: 29-SEP-1995 11:42:13.09
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4157.44	2	0	65.27	291.50	251	82	8.35E-06	70.7	
2	0	4412.93	0	0	0.00	383.00	345	77	0.00E+00	0.0	
3	0	4729.65	6	0	0.00	497.00	456	83	2.50E-05	40.8	
4	0	5270.08	10	0	221.36	693.00	651	85	4.17E-05	31.6	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 09:06:16

Spectral File: ND_AMS_ARCHIVE_S:S_78772$9369-004_UU.CNF

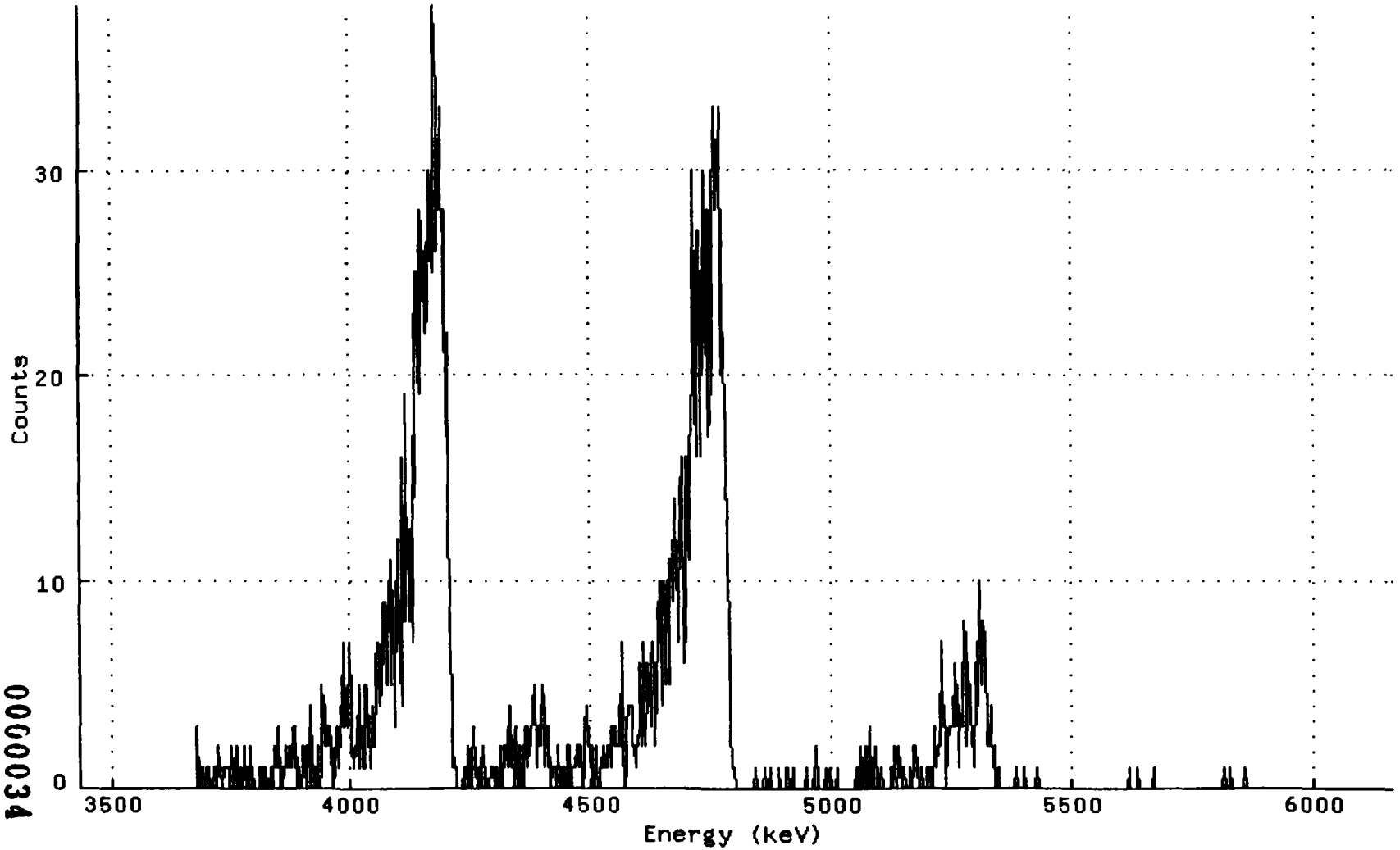
RELEASE/BATCH #	78772	SAMPLE ID:	9369-004
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.008E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	010
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	30.8%
ELAPSED LIVE TIME:	5989.	RECOVERY:	28.29%
TRACER ID:	U-232	TRACER FWHM (kev):	94.56
LAMBDA VALUE:	1000.	ROI TYPE:	EXPANDED
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_010_29SEP95		

NUCLIDE ACTIVITY SUMMARY

NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	195.70	0.30	99.8	1.006E+01	1.760E+00	2.702E-01	2.047E-01
U-234	4761.5	994.65	0.35	99.8	5.112E+01	1.082E+01	2.807E-01	2.100E-01
U-235	4385.5	117.78	0.22	80.9	7.467E+00	2.042E+00	3.117E-01	2.417E-01
U-238	4184.4	1023.85	0.15	100.2	5.239E+01	1.107E+01	2.308E-01	1.848E-01

*** POSITIVE ***

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.S]S_78772$9369-004_UU.CNF;1
Title : 010
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.42671E+03
Real Time : 0 01:39:48.99 Sample ID : 9369-004 Energy Slope : 2.64208E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 2.39620E-05



00000034

Channel Contents for ND_AMS_ARCHIVE_S:S_78772$9369-004_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	3
97:	0	1	0	1	0	0	1	1
105:	0	0	0	0	1	1	0	2
113:	1	0	0	1	1	1	1	1
121:	0	2	0	0	1	2	0	0
129:	1	0	0	1	2	0	1	0
137:	2	0	1	0	0	0	0	0
145:	1	1	1	0	1	0	0	0
153:	1	0	0	2	2	1	1	3
161:	0	1	0	1	1	2	1	2
169:	1	1	3	1	3	0	1	0
177:	0	1	2	1	0	2	2	0
185:	4	1	1	0	0	2	0	0
193:	1	5	4	2	4	2	3	3
201:	2	0	0	1	3	2	1	4
209:	2	4	7	3	4	5	3	7
217:	4	2	1	2	2	2	5	1
225:	3	1	5	1	5	2	3	1
233:	3	4	2	5	6	7	6	4
241:	5	9	6	9	5	7	10	5
249:	11	8	5	3	10	7	12	6
257:	4	16	8	19	8	13	12	8
265:	8	17	7	21	25	23	20	19
273:	28	27	25	22	22	23	30	26
281:	26	25	38	36	33	26	30	33
289:	29	27	28	25	17	22	12	10
297:	1	2	1	1	0	0	0	0
305:	0	1	0	1	0	2	0	0
313:	1	3	1	1	0	1	0	1
321:	2	0	1	0	0	0	1	1
329:	1	0	0	1	0	0	2	0
337:	2	1	2	1	2	4	1	2
345:	0	1	3	0	0	2	0	2
353:	0	3	3	1	2	2	2	4
361:	5	1	2	2	4	2	5	4
369:	1	3	1	3	0	1	1	1
377:	1	0	2	0	1	0	0	1
385:	0	0	2	2	0	1	1	1
393:	1	2	2	1	2	0	1	3
401:	4	2	2	2	0	2	0	2
409:	1	0	0	1	1	2	1	1
417:	2	1	2	1	3	3	3	2
425:	2	2	4	2	7	2	0	1

433:	3	4	4	4	2	2	1	2
441:	2	3	6	2	7	3	2	5
449:	6	5	3	6	7	5	2	5
457:	7	8	10	4	7	10	8	5
465:	10	5	11	11	9	10	14	10
473:	9	7	14	16	16	6	16	7
481:	16	11	16	18	20	30	19	16
489:	25	27	16	22	20	30	27	21
497:	28	17	18	20	27	33	30	28
505:	30	33	23	20	22	17	14	14
513:	4	3	1	1	1	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	1	0	0	0
537:	0	0	0	1	0	0	0	1
545:	0	0	0	0	0	0	1	0
553:	0	0	0	0	1	1	0	0
561:	0	1	0	0	0	0	0	0
569:	0	0	0	1	0	0	0	0
577:	0	1	0	2	0	0	0	0
585:	0	0	1	0	0	0	1	0
593:	0	0	0	1	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	1	0	0	2	1	0
617:	0	0	2	0	0	3	0	0
625:	1	2	0	1	0	1	0	0
633:	0	0	0	0	0	1	0	2
641:	1	0	1	2	1	0	1	1
649:	0	0	0	0	1	0	1	2
657:	2	1	0	0	1	0	0	0
665:	0	1	1	1	0	0	2	3
673:	1	2	2	2	7	5	3	3
681:	0	2	3	3	3	3	6	3
689:	5	1	4	3	3	4	8	7
697:	2	6	4	4	2	3	1	5
705:	7	4	10	6	5	8	7	7
713:	2	2	4	3	1	2	0	0
721:	1	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	1	0
737:	0	0	0	0	1	0	0	0
745:	0	0	0	0	0	0	1	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	1	0	0	0
825:	0	0	0	1	0	0	0	0
833:	0	0	0	0	0	0	0	1
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	1	0
897:	0	0	0	1	0	0	0	0
905:	0	0	0	0	0	0	1	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 09:05:20.57

Detector ID: 10 Acquisition Start: 3-OCT-1995 06:49:30.10
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: 9369-004
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4152.83	1024	0	69.64	274.15	230	87	1.71E-01	3.1	
2	0	4406.84	118	0	159.55	369.73	330	81	1.97E-02	9.2	
3	0	4723.92	995	0	70.98	488.82	447	87	1.66E-01	3.2	
4	0	5274.39	196	0	94.56	694.95	651	87	3.27E-02	7.1	

Background Counts Within Peak Regions Generated: 3-OCT-1995 09:05:32.79

Acquisition Start: 29-SEP-1995 11:42:13.10
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4146.94	6	0	0.00	273.00	230	87	2.50E-05	40.8	
2	0	4406.42	9	0	3.92	370.00	330	81	3.76E-05	33.3	
3	0	4727.55	14	0	2.67	490.00	447	87	5.84E-05	26.7	
4	0	5273.77	12	0	184.38	694.00	651	87	5.01E-05	28.9	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 08:55:15

Spectral File: ND_AMS_ARCHIVE_C:C_78772$LCS_UU.CNF

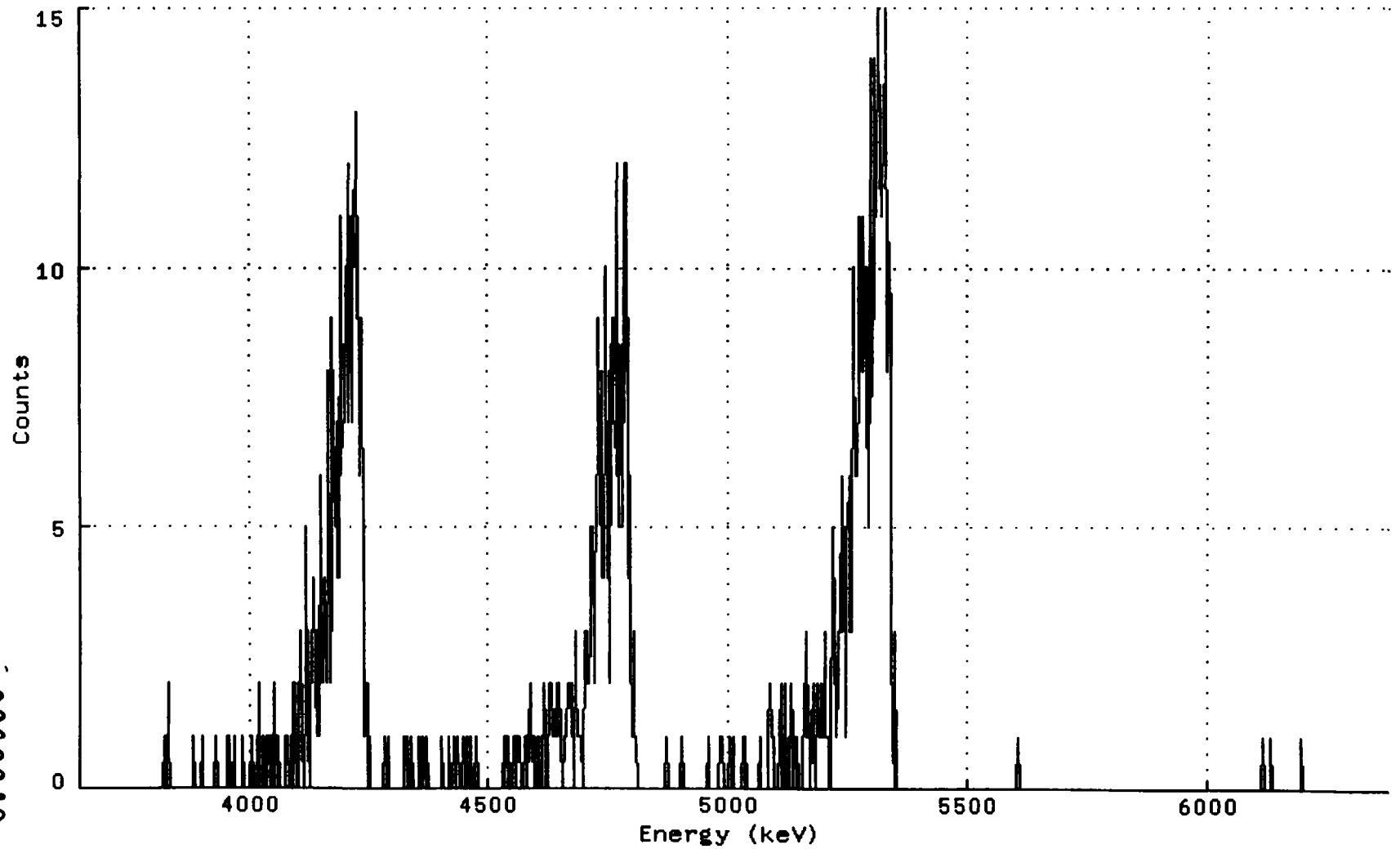
RELEASE/BATCH #	78772	SAMPLE ID:	LCS
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.000E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	001
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	28.9%
ELAPSED LIVE TIME:	5989.	RECOVERY:	57.34%
TRACER ID:	U-232	TRACER FWHM (kev):	74.98
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_001_29SEP95		

NUCLIDE ACTIVITY SUMMARY

NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	371.75	0.25	99.8	1.014E+01	1.473E+00	1.374E-01	1.057E-01
U-234	4761.5	250.78	0.22	99.8	6.842E+00	1.489E+00	1.341E-01	1.040E-01
U-235	4385.5	11.95	0.05	80.9	4.022E-01	2.439E-01	1.262E-01	1.087E-01
U-238	4184.4	290.95	0.05	100.2	7.905E+00	1.680E+00	1.019E-01	8.775E-02

*** POSITIVE ***

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.C]C_78772$LCS_UU.CNF;1
Title : 001
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.63739E+03
Real Time : 0 01:39:48.99 Sample ID : LCS Energy Slope : 2.53920E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 1.23052E-04



0000040

Channel Contents for ND_AMS_ARCHIVE_C:C_78772$LCS_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	1
73:	0	0	2	1	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	1
97:	0	0	0	0	0	0	1	0
105:	0	0	0	0	0	0	0	0
113:	0	1	0	0	0	0	0	0
121:	0	0	0	1	1	0	0	0
129:	1	0	0	0	0	0	0	1
137:	0	0	0	0	0	0	1	0
145:	0	0	0	0	2	0	0	0
153:	1	0	1	0	1	1	0	0
161:	2	0	1	0	1	0	0	0
169:	0	0	1	1	0	0	0	2
177:	0	2	1	0	2	0	3	1
185:	1	0	2	5	1	0	1	3
193:	3	4	2	1	3	1	6	2
201:	2	4	3	2	5	8	2	9
209:	3	8	8	5	7	4	4	11
217:	6	7	7	7	10	7	12	9
225:	7	11	10	13	12	10	8	6
233:	9	4	1	2	0	2	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	1	0	0	1	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	1	1	0	1	0	0
273:	1	0	0	0	0	0	1	0
281:	1	0	0	0	1	0	0	0
289:	0	0	0	0	0	0	0	0
297:	1	0	0	0	0	0	1	0
305:	0	0	1	0	0	1	0	0
313:	0	1	1	0	0	1	0	1
321:	0	0	0	0	1	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	1	0	1	0	1	0
353:	0	0	1	1	0	1	1	1
361:	0	0	0	1	1	0	1	2
369:	1	1	0	1	0	0	1	0
377:	1	0	2	1	0	0	2	2
385:	2	1	1	1	2	1	2	1
393:	1	0	1	1	1	2	2	2
401:	1	2	0	3	2	1	1	1
409:	1	0	0	3	3	2	2	3
417:	5	5	2	4	5	7	9	6
425:	4	8	4	8	10	4	8	2

433:	8	9	7	7	6	12	5	7
441:	8	5	12	7	12	4	9	3
449:	1	3	1	1	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	1	0	0	0	0
481:	0	0	0	0	0	0	0	1
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	1	0	0	0	0
513:	0	0	0	0	1	1	1	0
521:	0	0	0	0	1	0	1	0
529:	0	0	0	0	0	0	1	0
537:	1	0	0	0	0	0	0	0
545:	0	0	0	1	0	0	0	0
553:	0	0	1	2	1	1	0	0
561:	0	0	1	2	0	0	2	0
569:	0	1	0	2	1	0	1	0
577:	1	0	0	0	0	2	1	3
585:	1	1	0	1	2	1	0	2
593:	2	1	1	2	1	3	1	1
601:	1	0	0	5	2	4	1	2
609:	3	3	6	3	5	1	5	5
617:	6	3	3	10	9	6	6	8
625:	11	10	11	8	9	10	8	5
633:	14	7	8	10	14	11	15	15
641:	12	11	13	12	15	8	11	10
649:	9	3	1	0	3	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	1	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0

913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	1	0	0	0	0
937:	0	1	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	1	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 08:54:35.04

Detector ID: 1 Acquisition Start: 3-OCT-1995 06:49:30.01
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: LCS
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4190.57	291	0	71.01	215.60	175	65	4.86E-02	5.9	
2	0	4421.98	12	0	119.34	304.50	277	58	2.00E-03	28.9	
3	0	4753.42	251	0	66.01	430.54	396	63	4.19E-02	6.3	
4	0	5291.31	372	0	74.98	632.00	600	63	6.21E-02	5.2	

Background Counts Within Peak Regions Generated: 3-OCT-1995 08:54:48.79

Acquisition Start: 29-SEP-1995 11:42:13.01
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4169.77	2	0	63.09	207.00	175	65	8.35E-06	70.7	
2	0	4425.14	2	0	2.52	305.50	277	58	8.35E-06	70.7	
3	0	4743.72	9	0	0.00	427.00	396	63	3.76E-05	33.3	
4	0	5287.56	10	0	0.00	631.00	600	63	4.17E-05	31.6	

QUANTERRA
St. Louis

ALPHA SPECTROSCOPY REPORT
3-OCT-1995 08:53:41

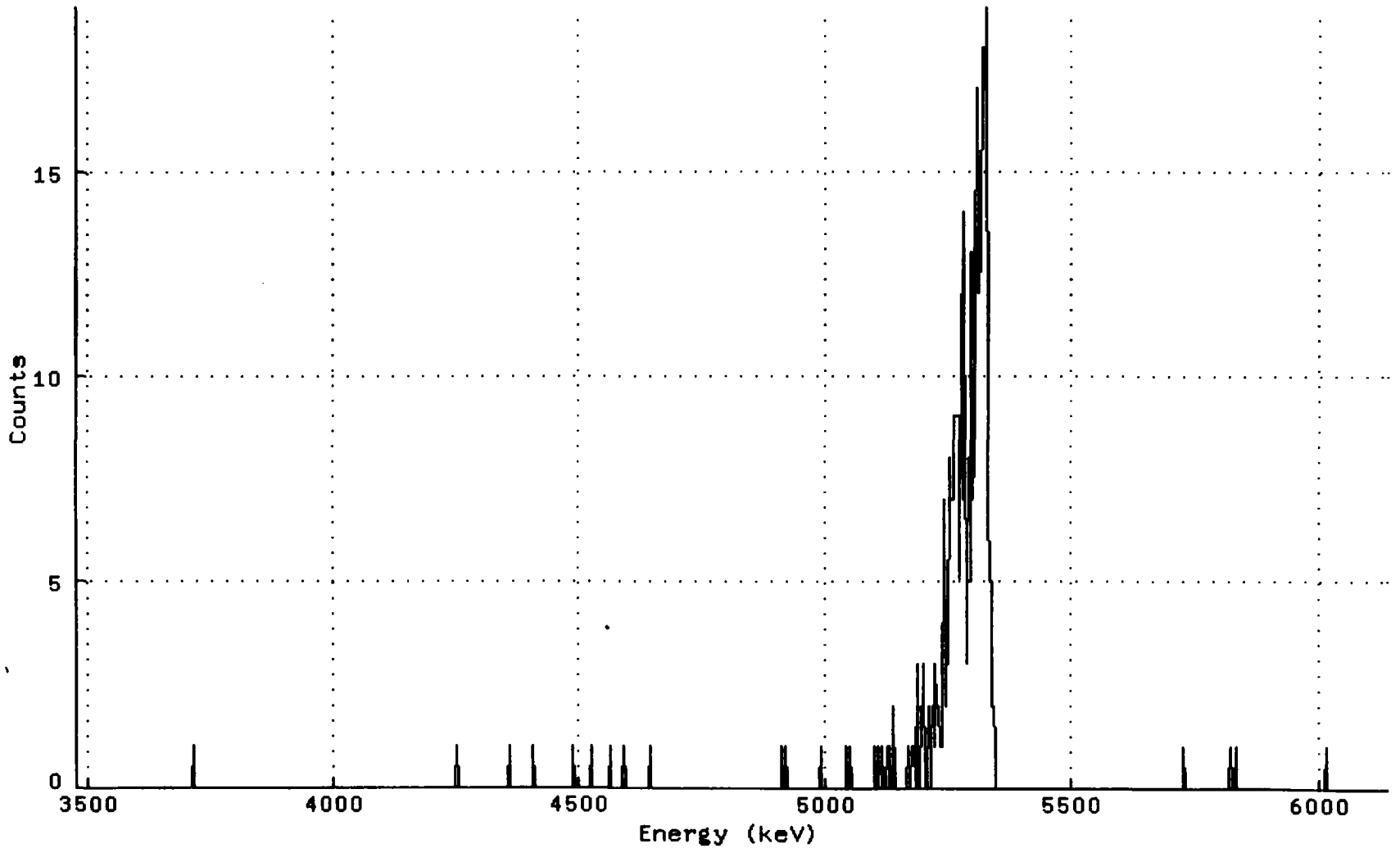
Spectral File: ND_AMS_ARCHIVE_R:R_78772$BLK_UU.CNF

RELEASE/BATCH #	78772	SAMPLE ID:	BLK
SAMPLE DATE:	3-OCT-1995 00:00:00.	ALIQUOT:	1.000E+00 gram
SAMPLE TITLE:		DETECTOR NUMBER:	003
ACQ DATE:	3-OCT-1995 06:49:30.	AVERAGE EFFICIENCY:	28.4%
ELAPSED LIVE TIME:	5989.	RECOVERY:	57.00%
TRACER ID:	U-232	TRACER FWHM (kev):	50.60
LAMBDA VALUE:	1000.	ROI TYPE:	STANDARD
CORRECTED TRACER DPM:	22.518	MDA MULTIPLIER:	4.65
SAMPLE MATRIX:	SOIL	MDA CONSTANT:	2.71
BKG FILENAME:	B_003_29SEP95		

NUCLIDE ACTIVITY SUMMARY

NUCLIDE	ENERGY	NET AREA	BKG	%ABN	ACTIVITY pCi/gram	TPU/ERROR 2-SIGMA	MDA pCi/gram	CRIT LEVEL pCi/gram
U-232	5302.5	362.78	0.22	99.8	1.014E+01	1.479E+00	1.374E-01	1.066E-01
U-234	4761.5	-0.05	0.05	99.8	-1.398E-03	1.993E-03	1.048E-01	9.031E-02
U-235	4385.5	2.93	0.07	80.9	1.009E-01	1.209E-01	1.374E-01	1.154E-01
U-238	4184.4	-0.02	0.02	100.2	-6.960E-04	1.397E-03	9.592E-02	8.568E-02

Spectrum : 1DIA3:[ALPHA.ALUSR.ARCHIVE.R]R_78772$BLK_UU.CNF;1
Title : 003
Sample Title:
Start Time: 3-OCT-1995 06:49: Sample Time: 3-OCT-1995 00:00: Energy Offset: 3.46759E+03
Real Time : 0 01:39:48.99 Sample ID : BLK Energy Slope : 2.54929E+00
Live Time : 0 01:39:48.99 Sample Type: UU Energy Quad : 5.37548E-05



0000046

Channel Contents for ND_AMS_ARCHIVE_R:R_78772$BLK_UU

Channel

1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	1
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	1	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	1	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	1	0	0
369:	0	0	0	0	0	0	0	0
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	1	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	1	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	1	0	0	0	0	0	0

433:	0	0	0	0	1	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	1	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	1
561:	0	0	1	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	1	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	1	0	0	1	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	1
633:	0	1	0	0	0	1	0	0
641:	0	1	0	1	0	0	2	0
649:	0	0	0	0	0	0	0	0
657:	0	1	0	0	1	1	1	0
665:	3	0	0	2	1	3	0	1
673:	0	2	0	1	2	1	3	2
681:	2	2	1	1	1	7	2	4
689:	3	8	7	7	7	9	9	9
697:	9	5	10	14	7	10	3	5
705:	8	5	13	7	8	12	17	13
713:	12	13	18	17	17	19	8	7
721:	5	5	2	2	1	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0
801:	0	0	0	0	0	0	0	0
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	1	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	1	0	0	0	1	0	0	0

```
 913:  0  0  0  0  0  0  0  0
 921:  0  0  0  0  0  0  0  0
 929:  0  0  0  0  0  0  0  0
 937:  0  0  0  0  0  0  0  0
 945:  0  0  0  0  0  0  0  0
 953:  0  0  0  0  0  0  0  0
 961:  0  0  0  0  0  0  0  0
 969:  0  0  0  0  0  0  0  0
 977:  1  0  0  0  0  0  0  0
 985:  0  0  0  0  0  0  0  0
 993:  0  0  0  0  0  0  0  0
1001:  0  0  0  0  0  0  0  0
1009:  0  0  0  0  0  0  0  0
1017:  0  0  0  0  0  0  0  0
```

QUANTERRA
St. Louis

Gross Sample Counts Within Peak Regions Generated: 3-OCT-1995 08:52:42.00

Detector ID: 3 Acquisition Start: 3-OCT-1995 06:49:30.03
Live Time: 0 01:39:48.99 Real Time: 0 01:39:48.99
Batch Id: 78772 Sample Id: BLK
Sample Type: UU

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4167.55	0	0	0.00	273.00	241	65	0.00E+00	0.0	
2	0	4418.19	3	0	130.01	370.00	344	59	5.01E-04	57.7	
3	0	4743.96	0	0	0.00	495.50	464	64	0.00E+00	0.0	
4	0	5292.27	363	0	50.60	705.27	672	64	6.06E-02	5.2	

Background Counts Within Peak Regions Generated: 3-OCT-1995 08:52:54.61

Acquisition Start: 29-SEP-1995 11:42:13.03
Live Time: 2 18:32:49.99 Real Time: 2 18:32:49.99

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	4167.83	1	0	2.53	273.00	241	65	4.17E-06	100.0	
2	0	4425.26	3	0	111.51	373.00	344	59	1.25E-05	57.7	
3	0	4742.32	2	0	20.27	495.50	464	64	8.35E-06	70.7	
4	0	5284.92	9	0	152.06	703.50	672	64	3.76E-05	33.3	

Quanterra
Environmental
Services

CALIBRATION DATA

Quanterra
Environmental
Services

INITIAL ENERGY AND FWHM CALIBRATION

Detector	Parameter	Flag	Filename
1	ALL	Passed	SECOND_001_10nov94
2	ALL	Passed	SECOND_002_10nov94
3	ALL	Passed	SECOND_003_10nov94
4	ALL	Passed	SECOND_004_10nov94
5	ALL	Passed	SECOND_005_10nov94
6	ALL	Passed	SECOND_006_10nov94
7	ALL	Passed	SECOND_007_10nov94
8	ALL	Passed	SECOND_008_10nov94
9	ALL	Passed	SECOND_009_10nov94
10	ALL	Passed	SECOND_010_10nov94
11	ALL	Passed	SECOND_011_10nov94
12	ALL	Passed	SECOND_012_10nov94
13	ALL	Passed	SECOND_013_10nov94
14	ALL	Passed	SECOND_014_10nov94
15	ALL	Passed	SECOND_015_10nov94
16	ALL	Passed	SECOND_016_10nov94
17	ALL	Passed	SECOND_017_10nov94
18	ALL	Passed	SECOND_018_10nov94
19	ALL	Passed	SECOND_019_10nov94
20	ALL	Passed	SECOND_020_10nov94
21	ALL	Passed	SECOND_021_10nov94
22	ALL	Passed	SECOND_022_10nov94
23	ALL	Passed	SECOND_023_10nov94
24	ALL	Passed	SECOND_024_10nov94
25	ALL	Passed	SECOND_025_10nov94
26	ALL	Passed	SECOND_026_10nov94
27	ALL	Passed	SECOND_027_10nov94
28	ALL	Passed	SECOND_028_10nov94
29	ALL	Passed	SECOND_029_10nov94
30	ALL	Passed	SECOND_030_10nov94
31	ALL	Passed	SECOND_031_10nov94
32	ALL	Passed	SECOND_032_10nov94

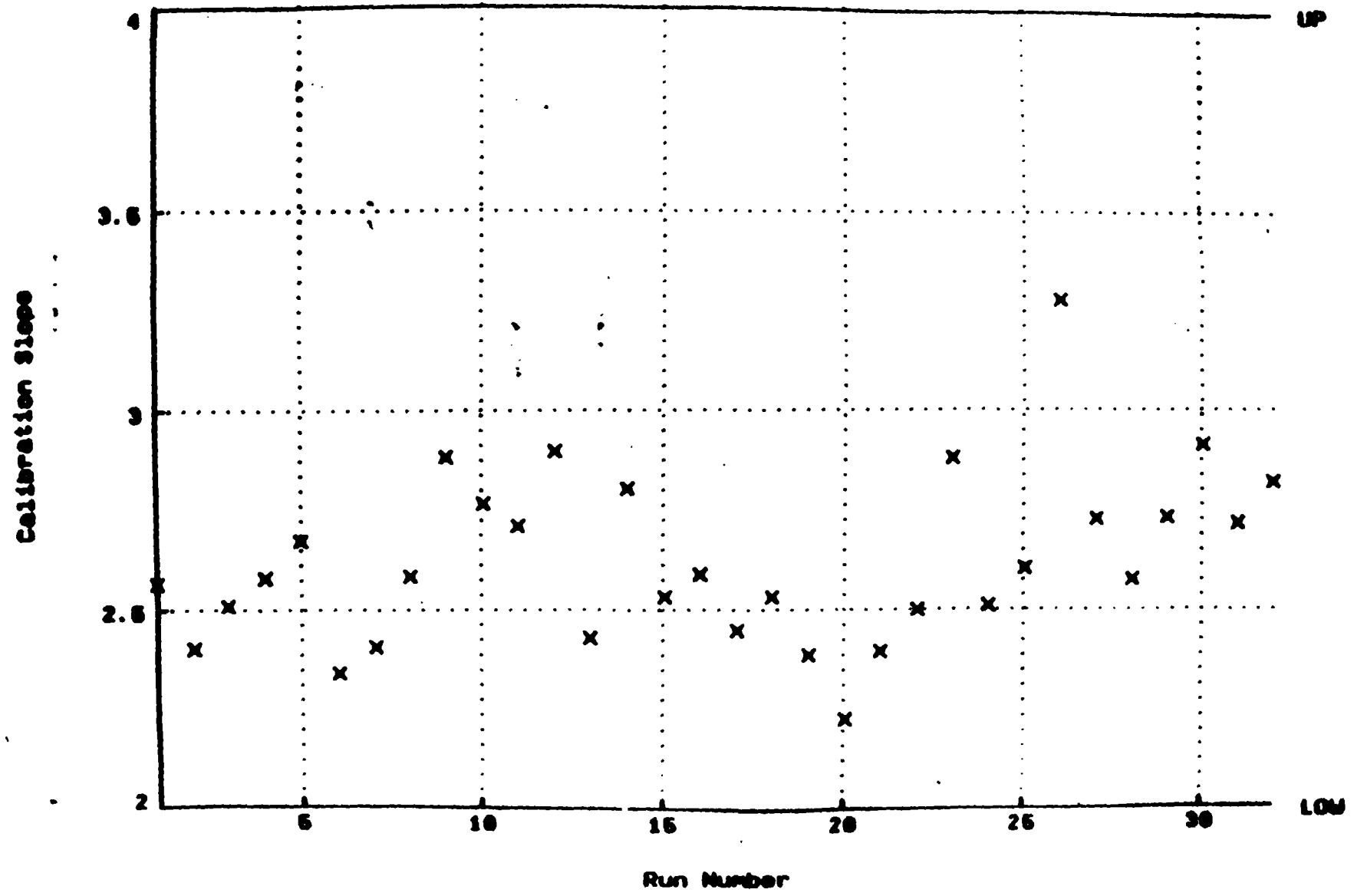
APPROVAL DATE: 12-9-94 APPROVAL TIME: 0900

APPROVED BY: [signature] PROCEDURE # NA

Report completed at 5-DEC-1994 15:39:43.52

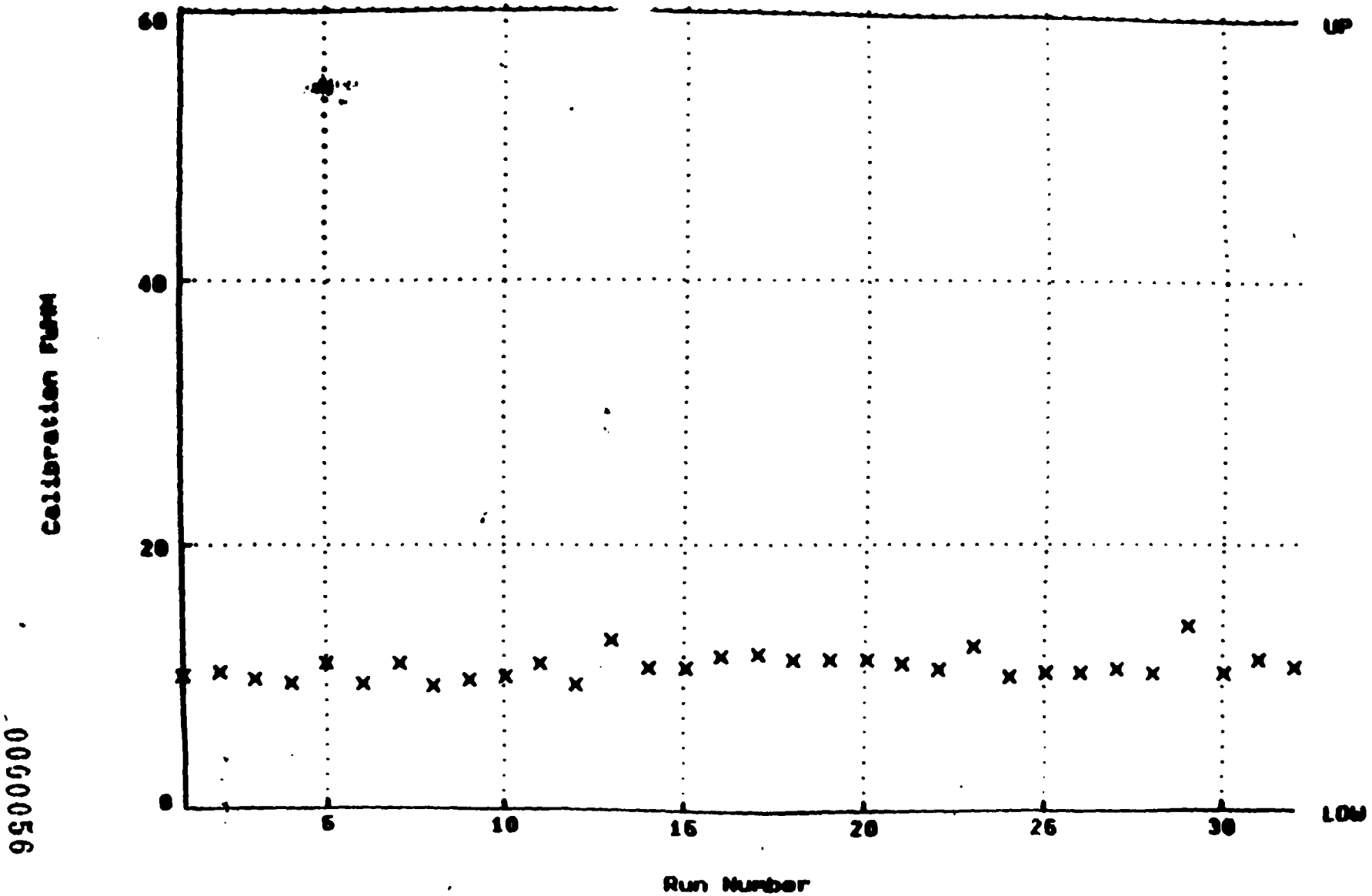
Det	Offset	Energy Slope	Quad	PMM Const	Avg %Eff	Calibration D
1	3625.	2.87	1.031E-04	10.94	30.97	10-NOV-1994 16:1
2	3572.	2.60	1.292E-04	10.53	31.64	10-NOV-1994 16:1
3	3477.	2.82	7.193E-05	10.22	30.60	10-NOV-1994 16:1
4	3516.	2.59	7.270E-05	10.09	31.09	10-NOV-1994 16:1
5	3379.	2.68	-3.779E-05	10.69	34.13	10-NOV-1994 16:1
6	3531.	2.35	1.404E-04	9.86	32.32	10-NOV-1994 16:1
7	3446.	2.42	8.361E-05	10.73	30.03	10-NOV-1994 16:1
8	3562.	2.59	4.148E-05	10.27	29.71	10-NOV-1994 16:1
9	3314.	2.89	-1.021E-04	10.04	30.83	10-NOV-1994 16:1
10	3379.	2.77	-5.994E-05	10.46	32.61	10-NOV-1994 16:1
11	3314.	2.72	-1.196E-05	10.13	29.67	10-NOV-1994 16:1
12	3362.	2.91	-7.894E-05	10.50	31.26	10-NOV-1994 16:1
13	3416.	2.44	8.269E-05	10.52	28.62	10-NOV-1994 16:1
14	3241.	2.81	-5.851E-05	10.07	30.95	10-NOV-1994 16:1
15	3495.	2.54	5.403E-05	10.17	31.51	10-NOV-1994 16:1
16	3579.	2.60	4.300E-05	10.35	30.62	10-NOV-1994 16:1
17	3276.	2.45	1.946E-04	11.12	39.19	10-NOV-1994 16:3
18	3254.	2.53	2.098E-04	10.90	39.50	10-NOV-1994 16:33
19	3460.	2.39	1.982E-04	11.47	38.95	10-NOV-1994 16:33
20	3474.	2.23	2.831E-04	11.38	40.03	10-NOV-1994 16:33
21	3398.	2.40	1.572E-04	10.75	41.34	10-NOV-1994 16:33
22	3511.	2.51	9.217E-05	10.40	37.76	10-NOV-1994 16:33
23	3157.	2.89	-5.735E-05	10.54	34.32	10-NOV-1994 16:33
24	3386.	2.52	9.413E-05	10.25	40.20	10-NOV-1994 16:33
25	3215.	2.61	1.114E-04	10.78	39.33	10-NOV-1994 16:33
26	2979.	3.29	-3.434E-04	9.97	41.64	10-NOV-1994 16:33
27	3173.	2.74	-8.031E-06	9.55	39.04	10-NOV-1994 16:33
28	3279.	2.58	3.511E-05	10.56	42.14	10-NOV-1994 16:33
29	3158.	2.74	-4.982E-06	10.58	39.07	10-NOV-1994 16:33
30	2837.	2.93	8.610E-05	9.42	40.84	10-NOV-1994 16:33
31	3160.	2.72	4.575E-05	10.34	42.01	10-NOV-1994 16:33
32	3142.	2.83	4.556E-05	9.58	38.07	10-NOV-1994 16:33
33	3464.	3.00	0.000E+00	15.00	30.00	
34	3464.	3.00	0.000E+00	15.00	30.00	
35	3464.	3.00	0.000E+00	15.00	30.00	
36	3464.	3.00	0.000E+00	15.00	30.00	
37	3464.	3.00	0.000E+00	15.00	30.00	
38	3464.	3.00	0.000E+00	15.00	30.00	
39	3464.	3.00	0.000E+00	15.00	30.00	
40	3464.	3.00	0.000E+00	15.00	30.00	
41	3464.	3.00	0.000E+00	15.00	30.00	
42	3464.	3.00	0.000E+00	15.00	30.00	
43	3464.	3.00	0.000E+00	15.00	30.00	
44	3464.	3.00	0.000E+00	15.00	30.00	
45	3464.	3.00	0.000E+00	15.00	30.00	
46	3464.	3.00	0.000E+00	15.00	30.00	
47	3464.	3.00	0.000E+00	15.00	30.00	
48	3464.	3.00	0.000E+00	15.00	30.00	

QA filename : $10DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;1
Parameter Name : ECSLOPE (Calibration Slope)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 2.00000 through 4.00000



0000055

QA filename : $18DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;1
Parameter Name : FWHMCONST (Calibration FWHM)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 0.000000E+00 through 60.0000



00000056

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Amersham
The Health Science C

CERTIFICATE

No. 6088-1

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	BA 920
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.63E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

i. A.

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Persönlich haftende Gesellschafterin
Amersham Buchler GmbH

Geschäftsführer
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0000057

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Amersham
The Health Science C

CERTIFICATE

No. 6088-2

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 921
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.57E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

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CERTIFICATE

No. 6088-3

for an Unsealed Radioactive Source

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Source Type: Checking Source

Product Code	QCRB2900
Drawing	VZ-1679
Quantity	1 off
Source No(s).	BA 922
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.2E03 1/s ± 5 % in 2 π geometry.

* see page 2 for explanation

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0000059

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Amersham
The Health Science G

CERTIFICATE

No. 6088-4

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 923
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.25E03 1/s ± 5 % in 2 π geometry.

* see page 2 for explanation

Amersham Buchler
i.A. [signature]

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CERTIFICATE

No. 6088-5

for an Unsealed Radioactive Source

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Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 924
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.36E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

0000061

Amersham Buchler — Persönlich haftende Gesellschafterin — Geschäftsführer — Deutsche Bank AG Braunschweig

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Amersha
The Health Science C

CERTIFICATE

No. 6088-6

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 925
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.40E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

[signature]

0000062

11 October 1994 Mm/wo
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CERTIFICATE

No. 6088-7

for an Unsealed Radioactive Source

Amersham
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Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 926
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.42E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

0000063

11 October 1994 Mm/wo
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Amersham
The Nuclear Science Co.

CERTIFICATE

No. 6068-8

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 927
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.40E03 1/s ± 5 % in 2 π emission.

* see page 2 for explanation

Amersham Buchler

0000064

11 October 1994 Mm/wo
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Amersha
The Health Science G

CERTIFICATE

No. 6088-9

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 928
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark: Alpha surface emission rate: 1.30E03 1/s ± 5 % in 2 π emission.

* see page 2 for explanation

Amersham Buchler

0000065

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Amersham
The Health Science Group

CERTIFICATE

No. 6088-10

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 929
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.43E03 1/s ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

0000066

11 October 1994 Mm/vo
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CERTIFICATE

No. 6088-11

for an Unsealed Radioactive Source

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Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 930
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.40E03 1/s ± 5 % in 2 π emission.

* see page 2 for explanation

Amersham Buchler

0000067

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Amersham
The Nuclear Source C

CERTIFICATE

No. 6088-12

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	ILA 931
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.24[illegible] Hz ± 5 % in 2 π steradian.

* see page 2 for explanation

Amersham [illegible]

0000068

11 October 1994 Mm/wo
Page 1 of 2 pages, Issue 0/00

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Amersha
The Nuclear Source C

CERTIFICATE

No. 6088-13

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 932
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.42800 1/s ± 5 % in 2 π emission.

* see page 2 for explanation

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0000369

11 October 1994 Mm/vo
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Amersham
The Nuclear Science Co.

CERTIFICATE

No. 6088-14

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 953
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.39[illegible] kB ± 5 % in 2 π emission.

* see page 2 for explanation

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0000070

11 October 1994 Mau/wo
Page 1 of 2 pages, Issue 0/00

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CERTIFICATE

No. 6088-15

for an Unsealed Radioactive Source

Amersham
The Nuclear Science Co

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	RA 934
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.41E03 1/s ± 5 %, in 2 π steradian.

* see page 2 for explanation

Amersham Buchler

0000071

11 October 1994 Mm/wo
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CERTIFICATE

No. 6088-16

for an Unsealed Radioactive Source

Source Type: Checking Source

Product Code	QCRB2500
Drawing	VZ-1679
Quantity	1 off
Source No(s).	EA 935
Nuclide(s)	Plutonium-239, Americium-241, Curium-244

Measurement Data

Nominal Activity	1 kBq Pu-239, 1 kBq Am-241, 1 kBq Cm-244
Reference Date	22 September 1994
Traceability*	Not applicable

Contamination Test

Test Method*	—
Test passed on	—

Additional Information

Remark	Alpha surface emission rate: 1.44 Bq/s ± 5 % at 2 π emission.

* see page 2 for explanation

Amersham Buchler

0000072

Quanterra
Environmental
Services

EFFICIENCY CALIBRATION

0000073

ALSPCDS.DOC

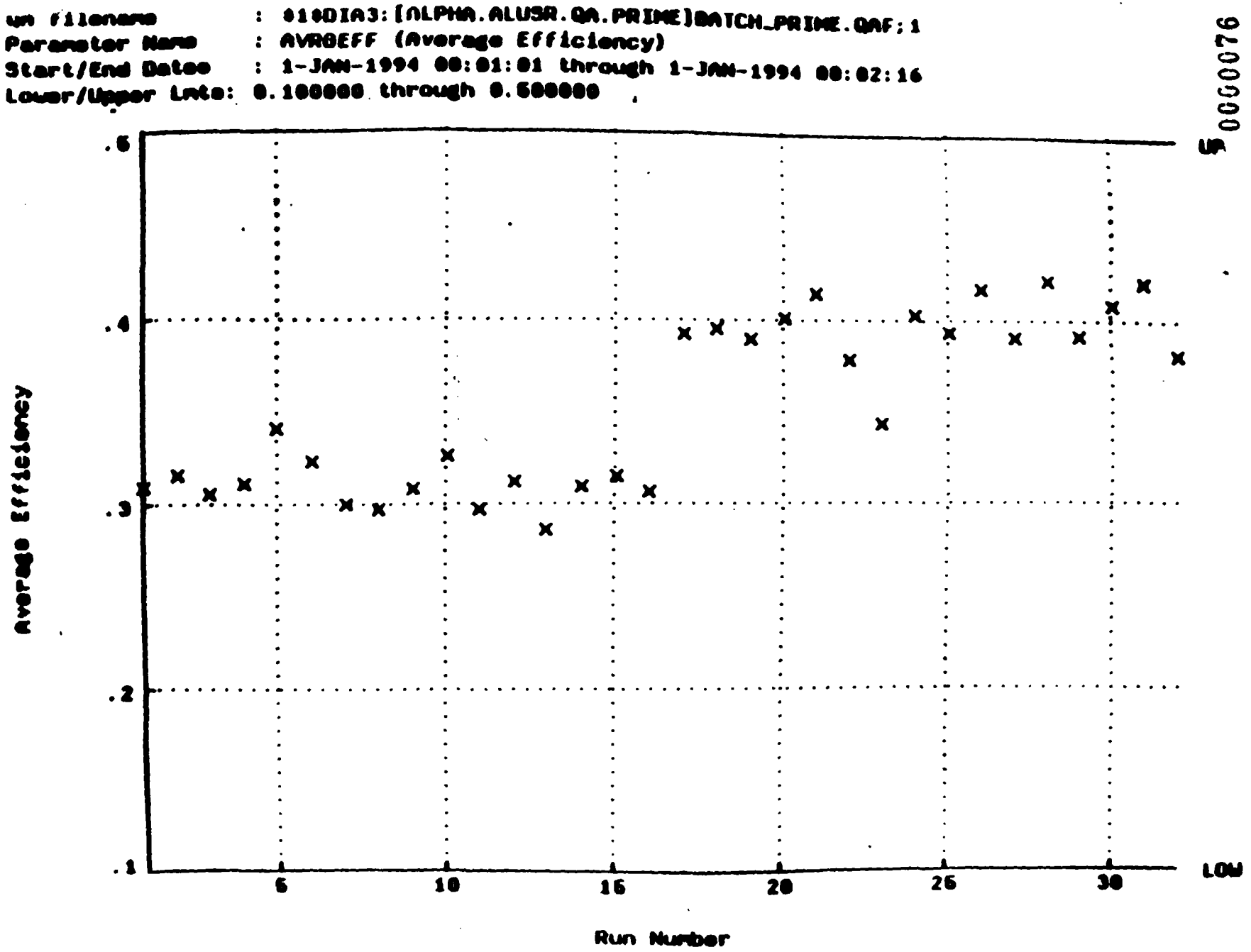
Detector	Parameter	Flag	Filename
1	ALL	Passed	PRIME_001_10NOV94.C
2	ALL	Passed	PRIME_002_10NOV94.C
3	ALL	Passed	PRIME_003_10NOV94.C
4	ALL	Passed	PRIME_004_10NOV94.C
5	ALL	Passed	PRIME_005_10NOV94.C
6	ALL	Passed	PRIME_006_10NOV94.C
7	ALL	Passed	PRIME_007_10NOV94.C
8	ALL	Passed	PRIME_008_10NOV94.C
9	ALL	Passed	PRIME_009_10NOV94.C
10	ALL	Passed	PRIME_010_10NOV94.C
11	ALL	Passed	PRIME_011_10NOV94.C
12	ALL	Passed	PRIME_012_10NOV94.C
13	ALL	Passed	PRIME_013_10NOV94.C
14	ALL	Passed	PRIME_014_10NOV94.C
15	ALL	Passed	PRIME_015_10NOV94.C
16	ALL	Passed	PRIME_016_10NOV94.C
17	ALL	Passed	PRIME_017_10NOV94.C
18	ALL	Passed	PRIME_018_10NOV94.C
19	ALL	Passed	PRIME_019_10NOV94.C
20	ALL	Passed	PRIME_020_10NOV94.C
21	ALL	Passed	PRIME_021_10NOV94.C
22	ALL	Passed	PRIME_022_10NOV94.C
23	ALL	Passed	PRIME_023_10NOV94.C
24	ALL	Passed	PRIME_024_10NOV94.C
25	ALL	Passed	PRIME_025_10NOV94.C
26	ALL	Passed	PRIME_026_10NOV94.C
27	ALL	Passed	PRIME_027_10NOV94.C
28	ALL	Passed	PRIME_028_10NOV94.C
29	ALL	Passed	PRIME_029_10NOV94.C
30	ALL	Passed	PRIME_030_10NOV94.C
31	ALL	Passed	PRIME_031_10NOV94.C
32	ALL	Passed	PRIME_032_10NOV94.C

APPROVAL DATE: 12-9-94 APPROVAL TIME: 0900

APPROVED BY: [signature] PROCEDURE # N/A

Report completed at 5-DEC-1994 11:38:05.10

Det	Offset	Energy Slope	Quad	PMT Const	Avg %Eff	Calibration Dat
1	3626.	2.56	1.089E-04	10.00	32.31	10-NOV-1994 12:57
2	3572.	2.40	1.268E-04	10.25	32.26	10-NOV-1994 12:57
3	3479.	2.81	7.854E-05	9.75	31.75	10-NOV-1994 12:57
4	3518.	2.58	7.862E-05	9.50	32.33	10-NOV-1994 12:57
5	3382.	2.67	-1.062E-05	11.00	31.53	10-NOV-1994 12:57
6	3534.	2.34	1.469E-04	9.50	32.46	10-NOV-1994 12:57
7	3449.	2.41	8.979E-05	11.00	32.19	10-NOV-1994 12:57
8	3564.	2.58	4.722E-05	9.25	31.76	10-NOV-1994 12:57
9	3317.	2.88	-9.599E-05	9.75	32.11	10-NOV-1994 12:57
10	3381.	2.76	-5.366E-05	10.00	31.85	10-NOV-1994 12:57
11	3317.	2.71	-3.197E-06	11.00	32.03	10-NOV-1994 12:57
12	3364.	2.89	-7.144E-05	9.50	31.99	10-NOV-1994 12:57
13	3419.	2.43	8.911E-05	12.75	31.22	10-NOV-1994 12:57
14	3245.	2.80	-4.975E-05	10.75	31.78	10-NOV-1994 15:41
15	3497.	2.53	6.135E-05	10.75	32.10	10-NOV-1994 12:57
16	3581.	2.59	5.111E-05	11.50	32.25	10-NOV-1994 12:57
17	3278.	2.45	1.978E-04	11.75	43.78	10-NOV-1994 13:34
18	3284.	2.53	2.051E-04	11.25	44.09	10-NOV-1994 13:34
19	3461.	2.39	2.002E-04	11.25	43.84	10-NOV-1994 13:34
20	3475.	2.23	2.874E-04	11.25	43.47	10-NOV-1994 13:34
21	3400.	2.39	1.620E-04	11.00	43.47	10-NOV-1994 13:34
22	3512.	2.50	9.735E-05	10.50	44.56	10-NOV-1994 13:34
23	3160.	2.88	-5.177E-05	12.25	43.19	10-NOV-1994 13:34
24	3388.	2.51	9.847E-05	10.00	43.65	10-NOV-1994 13:34
25	3219.	2.60	1.186E-04	10.25	44.95	10-NOV-1994 13:34
26	2982.	3.28	-3.373E-04	10.25	43.94	10-NOV-1994 13:34
27	3177.	2.72	-1.396E-06	10.50	44.49	10-NOV-1994 13:34
28	3282.	2.57	4.137E-05	10.25	44.53	10-NOV-1994 13:34
29	3161.	2.73	-7.154E-07	13.75	43.84	10-NOV-1994 13:34
30	2843.	2.91	9.787E-05	10.25	43.98	10-NOV-1994 13:34
31	3162.	2.71	4.952E-05	11.25	44.79	10-NOV-1994 13:34
32	3146.	2.82	5.364E-05	10.75	42.03	10-NOV-1994 13:34
33	3464.	3.00	0.000E+00	15.00	30.00	
34	3464.	3.00	0.000E+00	15.00	30.00	
35	3464.	3.00	0.000E+00	15.00	30.00	
36	3464.	3.00	0.000E+00	15.00	30.00	
37	3464.	3.00	0.000E+00	15.00	30.00	
38	3464.	3.00	0.000E+00	15.00	30.00	
39	3464.	3.00	0.000E+00	15.00	30.00	
40	3464.	3.00	0.000E+00	15.00	30.00	
41	3464.	3.00	0.000E+00	15.00	30.00	
42	3464.	3.00	0.000E+00	15.00	30.00	
43	3464.	3.00	0.000E+00	15.00	30.00	
44	3464.	3.00	0.000E+00	15.00	30.00	
45	3464.	3.00	0.000E+00	15.00	30.00	
46	3464.	3.00	0.000E+00	15.00	30.00	
47	3464.	3.00	0.000E+00	15.00	30.00	
48	3464.	3.00	0.000E+00	15.00	30.00	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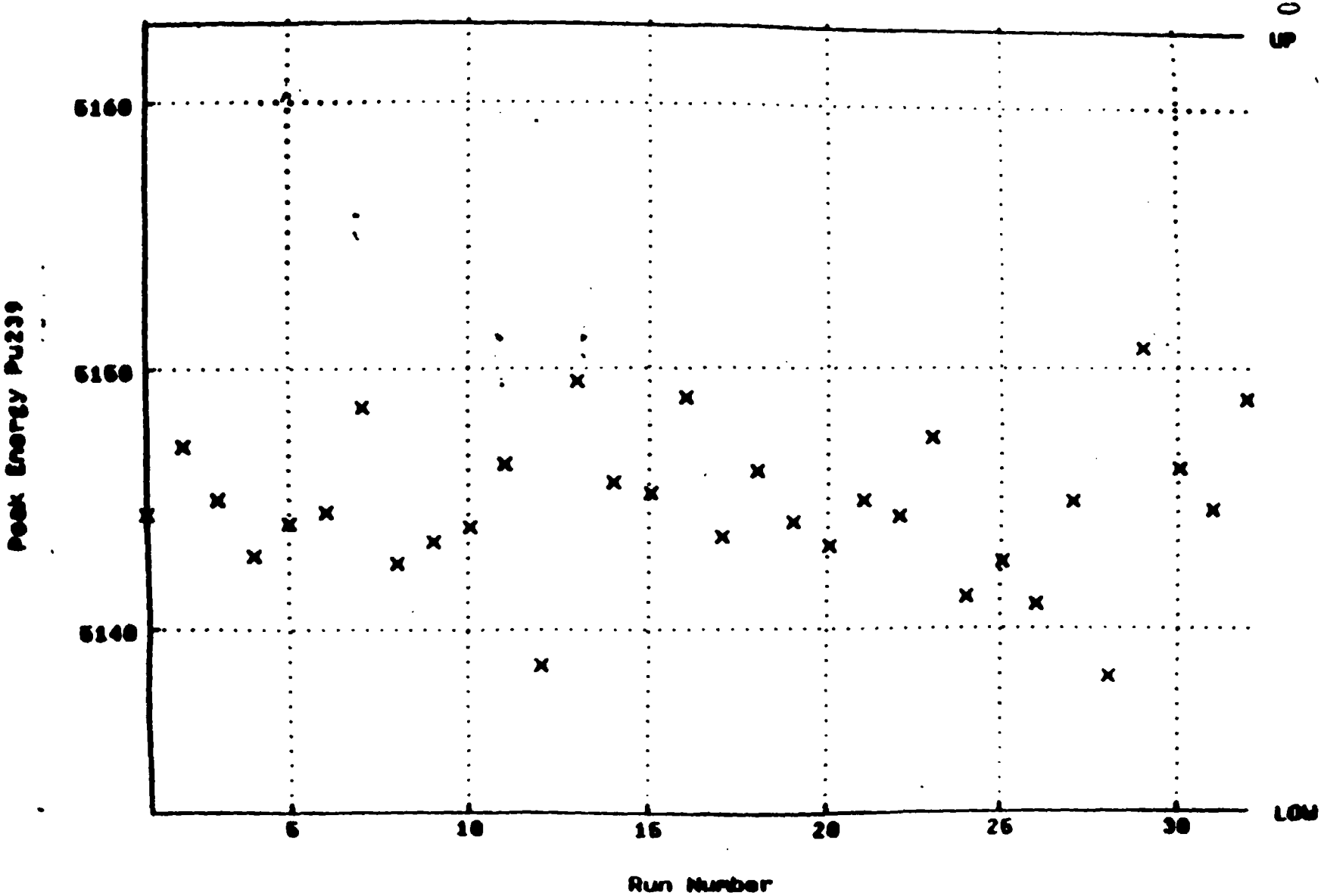
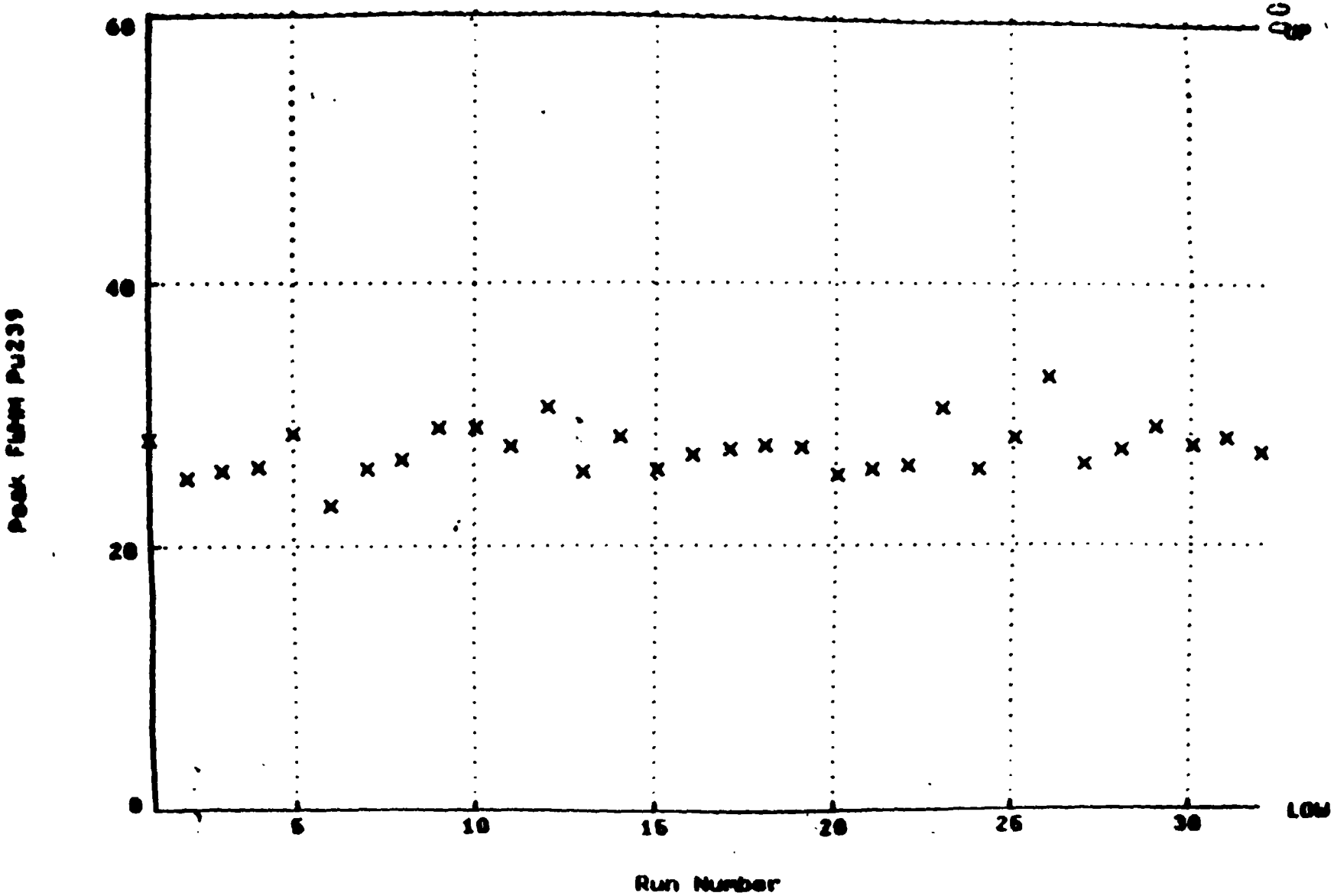
Parameter Name : AVRGEFF (Average Efficiency)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 0.100000 through 0.500000
UP
LOW
Average Efficiency
.5
.4
.3
.2
.1
5
10
15
20
25
30
Run Number

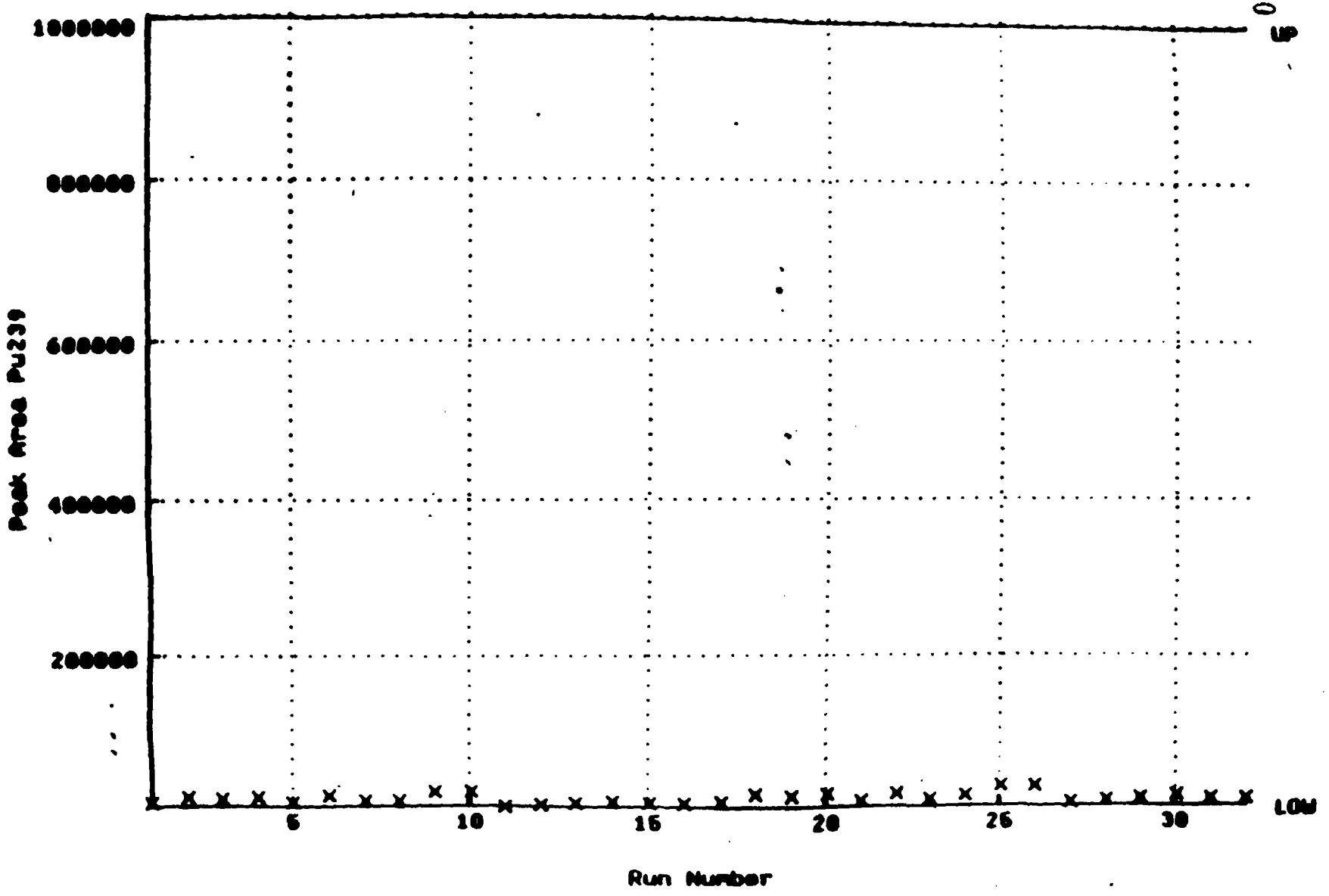
QA filename : 616DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;1
Parameter Name : PSENERGY-PU239 (Peak Energy Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 5133.00 through 5163.00



QA filename : 818DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;1
Parameter Name : PSFLWM-PU239 (Peak FLWM Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 0.000000E+00 through 60.0000



QA filename : 010DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;1
Parameter Name : PSAREA-PU239 (Peak Area Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 10000.0 through 1.000000E+06



Quanterra
Environmental
Services

EFFICIENCY CALIBRATION STANDARDS

ALSPCD7.DOC

0000080

[redacted] Laboratory
[redacted]
[redacted]
(505) 345-3461 • FAX # (505) 781-6410

SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS

"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package - limited quantity of material, UN 2910 and 49 CFR 173.422 for radioactive material, excepted package - instruments or articles, UN 2910."

I hereby certify that this package also conforms to all packaging requirements of the U.S. Department of Transportation and the International Air Transport Association (IATA) Rules and Regulations regarding the shipment of radioactive materials.

The materials are packed in strong, tight packages that will not leak during normal transport conditions, the radiation level on the exterior surface of the package does not exceed 0.5 mrem/hr., nonfixed (removable) contamination does not exceed applicable limits, and the outside of the inner container bears the marking "Radioactive".

No other labels are required.

SOURCE INFORMATION

Model No.	Isotope	Total Activity	Total Quantity	Serial No.
DMS-10	^{239}Pu ^{230}Th ^{241}Am	0.196μCi	48	1918-94 Through 1933-94 1934-94 Through 1949-94 C7271 Through 1968-94

Customer: [redacted] Inc.
[redacted] City, [redacted] 63045

PO# 130552
SO# 3-02900

Authorized Signature

Date 10/11/94

0000081

[redacted]
(505) 345-3461 • [redacted] (505) 761-6410

CUSTOMER: Quanterra, Inc.

ADDRESS: 13715 Rider Trail North
Earth City, MO 63045

Quality Control & Inspection

P.O. NUMBER: 130552

TMA/EBERLINE S.O. NUMBER: S-02900

DATE SHIPPED: 10/19/94

CERTIFICATE OF COMPLIANCE

The radioactive sources or services comprising this order have been subjected to and have passed all examinations, inspections, tests and calibrations of the TMA/Eberline quality assurance procedures, and, as applicable, are in compliance with specifications imposed by the above referenced contract/ purchase order number.

Calibration has been accomplished in accordance with TMA/Eberline calibration procedures. Sources for calibration and/or dose rates have calibration traceable to National Institute of Standards and Technology.

The undersigned as the authorized representative of TMA/Eberline warrants the information contained within this document to be a true statement of fact.

[redacted]

Quality Assurance Manager

0000082

[redacted]
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1918-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 c

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

2,210 ± 89

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

[redacted] ± 177 (0.00199 µCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 99% confidence level and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Representative: [signature]

Calibration date: 9/30/94 Reviewed date: 10-18-94

0000083

[redacted]
7021 Pan American Hwy. NE
Albuquerque, [redacted]
(505) 345-3461 FAX # (505) 761-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DBS-10 Serial No. 1919-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

3,400 ± 102

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

[redacted] ± 204 (0.00306 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] A Representative: [signature]

Calibration date: 9/27/94 Reviewed date: 10.18.94

0000084

TRW/Electro Albuquerque Laboratory
7801 Fun Arrington Hwy. NE
Albuquerque, NM 87109
(505) 345-3401 • FAX # (505) 761-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1920-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NBST by reference to an NIST calibrate alpha source S/N <393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

3,140 ± 126

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was

6,290 ± 252 (0.00283 µCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 95% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by:

Calibration technician: Representative:

Calibration date: 9/27/94 Reviewed date: 10-18-94

0000085

[illegible] Laboratory
7831 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3431 • FAX # (505) 761-8418

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1921-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolu counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (dpm) on the calibration dat was

3,320 ± 166

The total disintegration rate (dpm) assuming 1.9% backscatter of alpha particles from the surface of the disc was

[redacted] ± 332 (0.00299 µCi)

The uncertainty of the measurement is 5 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] QA Representative: [signature]

Calibration date: 9/26/94 Reviewed date: 10.18.94

0000086

[redacted] Albuquerque Laboratory
[redacted]
Albuquerque, [redacted]
([redacted]) [redacted] FAX # ([redacted]) 781-8418

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DRS-10 Serial No. 1922-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thick

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

2,140 ± 107

The total disintegration rate (dpm) assuming 1.8π backscatter of alpha particles from the surface of the disc was:

[redacted] ± 214 (0.00193 μCi)

The uncertainty of the measurement is 5 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Approved by: [signature]

Calibration date: 9/27/94 Reviewed date: 10-13-94

0000087

TMA/Eberline Albuquerque Laboratory
7051 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-6418

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DES-10 Serial No. 1923-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration dat was

3,630 ± 109

The total disintegration rate (dpm) assuming 1.9% backscatter of alpha particles from the surface of the disc was

[redacted] ± 218 (0.00327 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Representative: [signature]

Calibration date: 9/27/94 Reviewed date: 10-12-94

0000088

[redacted]
[redacted]
[redacted]
[redacted]

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1924-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

2,800 ± 84

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

[redacted]130 ± 168 (0.00253 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Representative: [signature]

Calibration date: 9/28/94 Reviewed date: 10-18-94

0000089

FMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1925-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 centered on active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NBST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (apm) on the calibration date was

2,890 ± 115

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

[redacted]770 ± 231 (0.00260 µCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 95% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Representative: [signature]

Calibration date: 9/28/94 Reviewed date: 10-18-94

0000090

TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3407 • FAX # (505) 781-6418

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1926-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 c

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the act surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolu counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration dat was

4,560 ± 137

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc was

4,130 ± 274 (0.00411 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by:

Calibration technician: Representative:

Calibration date: 9/27/94 Reviewed date: 10-18-94

0000091

TMA/Eberline Albuquerque Laboratory
7021 Pan American Fwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX • (505) 791-6418

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DSG-10 Serial No. 1927-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

4,390 ± 132

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was

[redacted] ± 264 (0.00396 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Supervisor: [signature]

Calibration date: 9/27/94 Reviewed date: 10.8.94

0000092

TRA/Eberline Albuquerque Laboratory
7191 Appaloosa Road, NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 767-8416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DKS-10 Serial No. 1928-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thick

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

1,880 ± 56

The total disintegration rate (dpm) assuming 1.8% backscatter of alpha particles from the surface of the disc. was

[redacted]770 ± 113 (0.00170 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: Dirk Kurt

Calibration technician: Arlene Gutierrez Representative: Keith Burnham

Calibration date: 9/27/94 Reviewed date: 10-6-94

0000093

[redacted]
(505) 345-3461 [redacted] (505) 767-6410

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DES-10 Serial No. 1929-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the activ surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

2,130 ± 64

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

[redacted] ± 128 (0.00192 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Representative: [signature]

Calibration date: 9/30/94 Reviewed date: 10-19-94

0000094

TRA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • TELEX 9 (505) 781-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DMS-10 Serial No. 1930-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thi

Total diameter of 2.23 cm and an active diameter of 1.91 c

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the act surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolu counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration dat was

2,600 ± 78

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc was

[redacted] ± 156 (0.00234 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [signature]

Calibration technician: [signature] Q.A. Representative: [signature]

Calibration date: 9/28/94 Reviewed date: 10-6-94

0000095

TSA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-6416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DES-10 Serial No. 1931-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thi

Total diameter of 2.23 cm and an active diameter of 1.91 c

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolu counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrat alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration dat was

2,850 ± 114

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc was

5,710 ± 228 (0.00257 µCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 95% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arturo Gutierrez Reviewed by:

Calibration technician: QA Representative:

Calibration date: 9/28/94 Reviewed date: 10-8-94

0000096

[redacted]
[redacted]
[redacted]
[redacted]

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DRS-10 Serial No. 1932-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cm

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the activ surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolut counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

2,360 ± 94

The total disintegration rate (dpm) assuming 1.8% backscatter of alpha particles from the surface of the disc, was

[redacted] ± 189 (0.00212 µCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by: [redacted]

Calibration technician: [redacted] Supervisor: [redacted]

Calibration date: 9/26/94 Reviewed date: 10-6-94

0000097

TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02900
P.O.# 130552

Description of Standard:

Model No. DES-10 Serial No. 1933-94 Isotope Plutonium-239

Electroplated on polished Stainless Steel disc, 0.79 mm thic

Total diameter of 2.23 cm and an active diameter of 1.91 cr

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the acti surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolu counting of alpha particles emitted in the hemisphere above the active surface was verified by counting abov below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrate alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (dpm) on the calibration dat was

2,410 ± 96

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc was

4,818 ± 193 (0.00217 μCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez Reviewed by:

Calibration technician: Arlene Gutierrez Representative:

Calibration date: 9/28/94 Reviewed date: 10-18-94

0000098

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INSTRUMENT CHECKS

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Services

DAILY PULSER CHECK

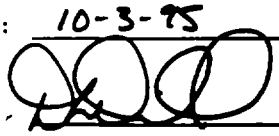
ALSPIC2.DOC

0600100

Review of QA results (Daily Pulser Check) 3-OCT-1995 06:25:12.65

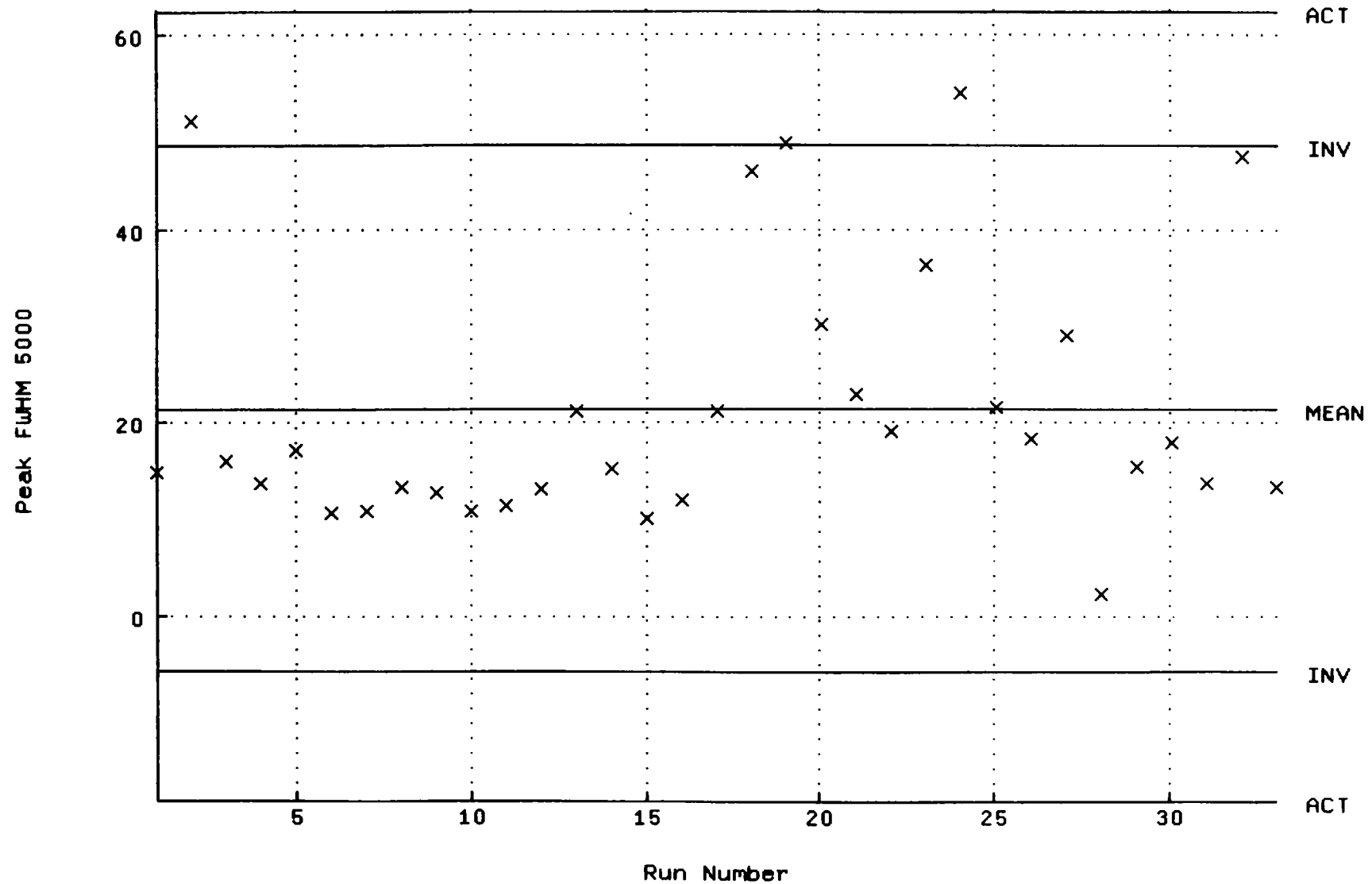
Detector	Parameter	Flag	Filename
1	ALL	Passed	D_001_NONE
2	PSENERGY-5000	Action	D_002_NONE
3	ALL	Passed	D_003_NONE
4	ALL	Passed	D_004_NONE
5	ALL	Passed	D_005_NONE
6	ALL	Passed	D_006_NONE
7	ALL	Passed	D_007_NONE
8	ALL	Passed	D_008_NONE
9	ALL	Passed	D_009_NONE
10	ALL	Passed	D_010_NONE
11	ALL	Passed	D_011_NONE
12	ALL	Passed	D_012_NONE
13	ALL	Passed	D_013_NONE
14	ALL	Passed	D_014_NONE
15	ALL	Passed	D_015_NONE
16	ALL	Passed	D_016_NONE
17	ALL	Passed	D_017_NONE
18	ALL	Passed	D_018_NONE
19	ALL	Passed	D_019_NONE
20	ALL	Passed	D_020_NONE
21	ALL	Passed	D_021_NONE
22	ALL	Passed	D_022_NONE
23	ALL	Passed	D_023_NONE
24	ALL	Passed	D_024_NONE
25	ALL	Passed	D_025_NONE
26	ALL	Passed	D_026_NONE
27	ALL	Passed	D_027_NONE
28	ALL	Passed	D_028_NONE
29	ALL	Passed	D_029_NONE
30	ALL	Passed	D_030_NONE
31	ALL	Passed	D_031_NONE
32	PSFWHM-5000	Action	D_032_NONE

APPROVAL DATE: 10-3-95 APPROVAL TIME: 1050

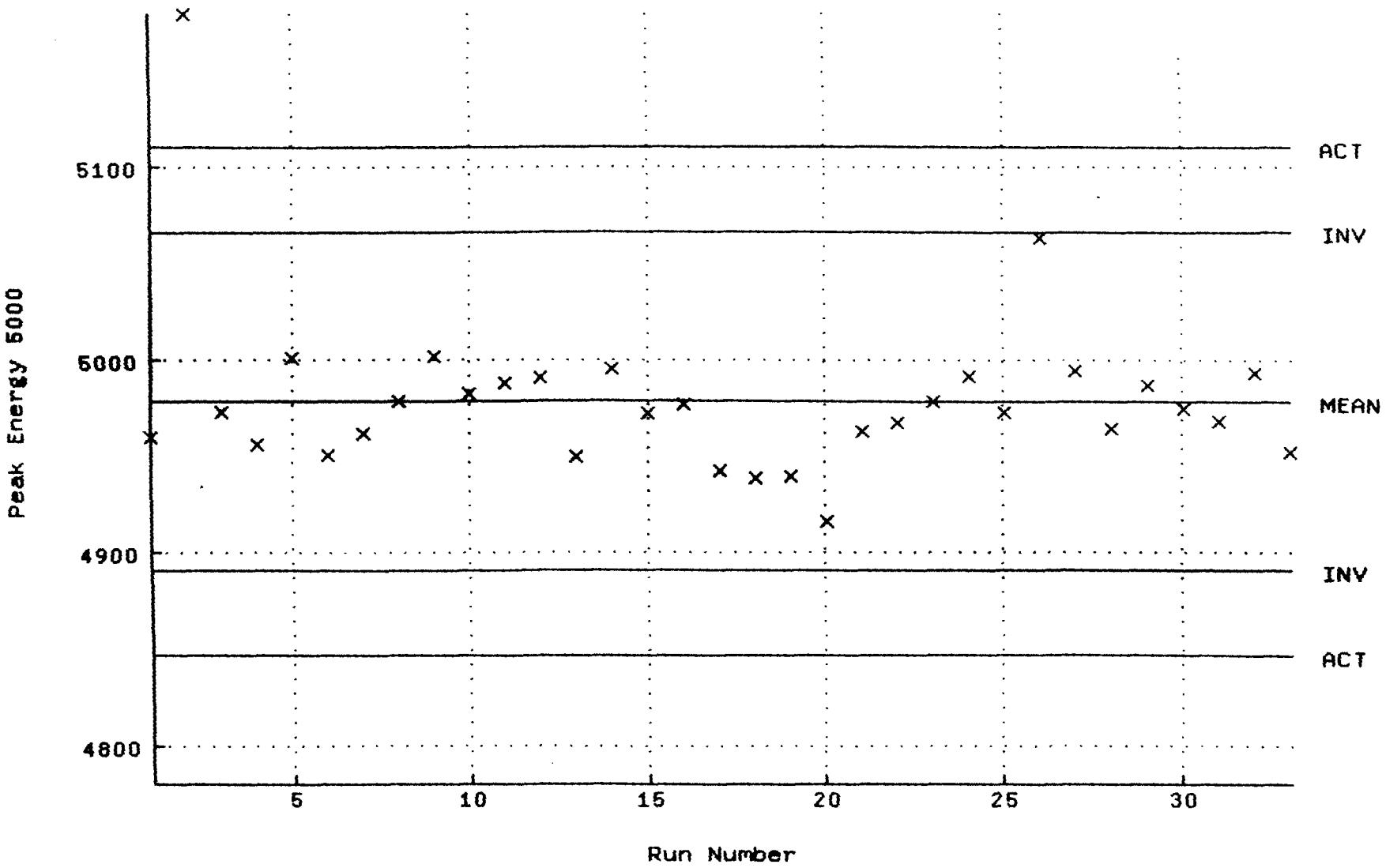
APPROVED BY:  PROCEDURE # 13007

Report completed at 3-OCT-1995 06:30:20.91

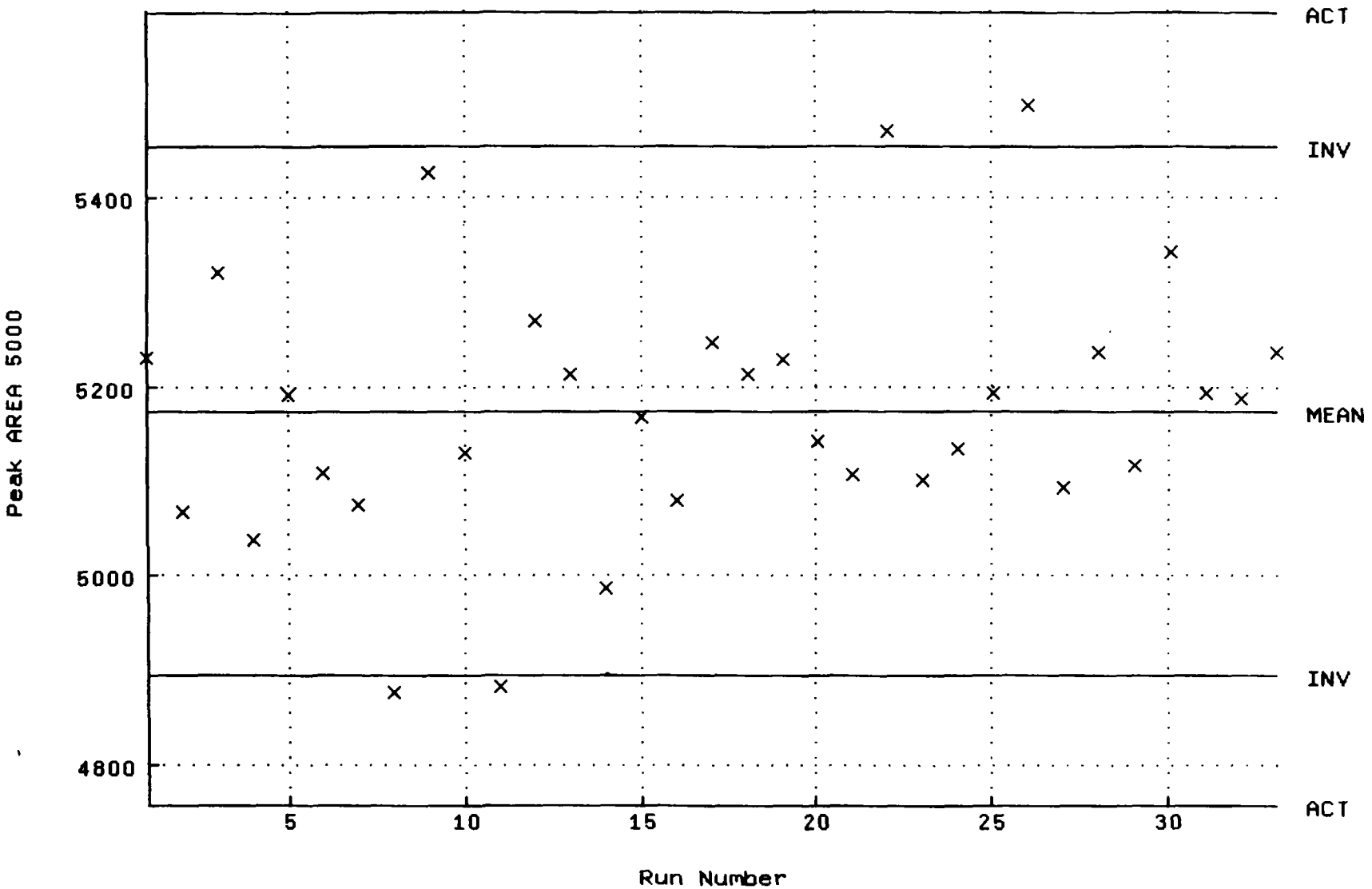
QA filename : 1DIA3:[ALPHA.ALUSR.QA.D]BATCH_D.QAF;1
Parameter Name : PSFWHM-5000 (Peak FWHM 5000)
Start/End Dates : 1-JAN-1994 00:01:01 through 24-JAN-1995 08:35:41
Mean +- Std Dev : 21.5105 +- 13.5914 (63.18 %)



filename : 1DIA3:[...
arameter Name : PSENERGY-5000 (Peak ...
tart/End Dates : 1-JAN-1994 00:01:01 through ...
lean +- Std Dev : 4978.80 +- 43.9110 (0.88 %)



QA filename : 1DIA3:[ALPHA.ALUSR.QA.D]BATCH_D.QAF;1
Parameter Name : PSAREA-5000 (Peak AREA 5000)
Start/End Dates : 1-JAN-1994 00:01:01 through 24-JAN-1995 08:35:41
Mean +- Std Dev : 5174.73 +- 139.102 (2.69 %)



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WEEKLY CALIBRATION UPDATE

Review of QA results (Energy Calibration Check) 2-OCT-1995 12:20:00.

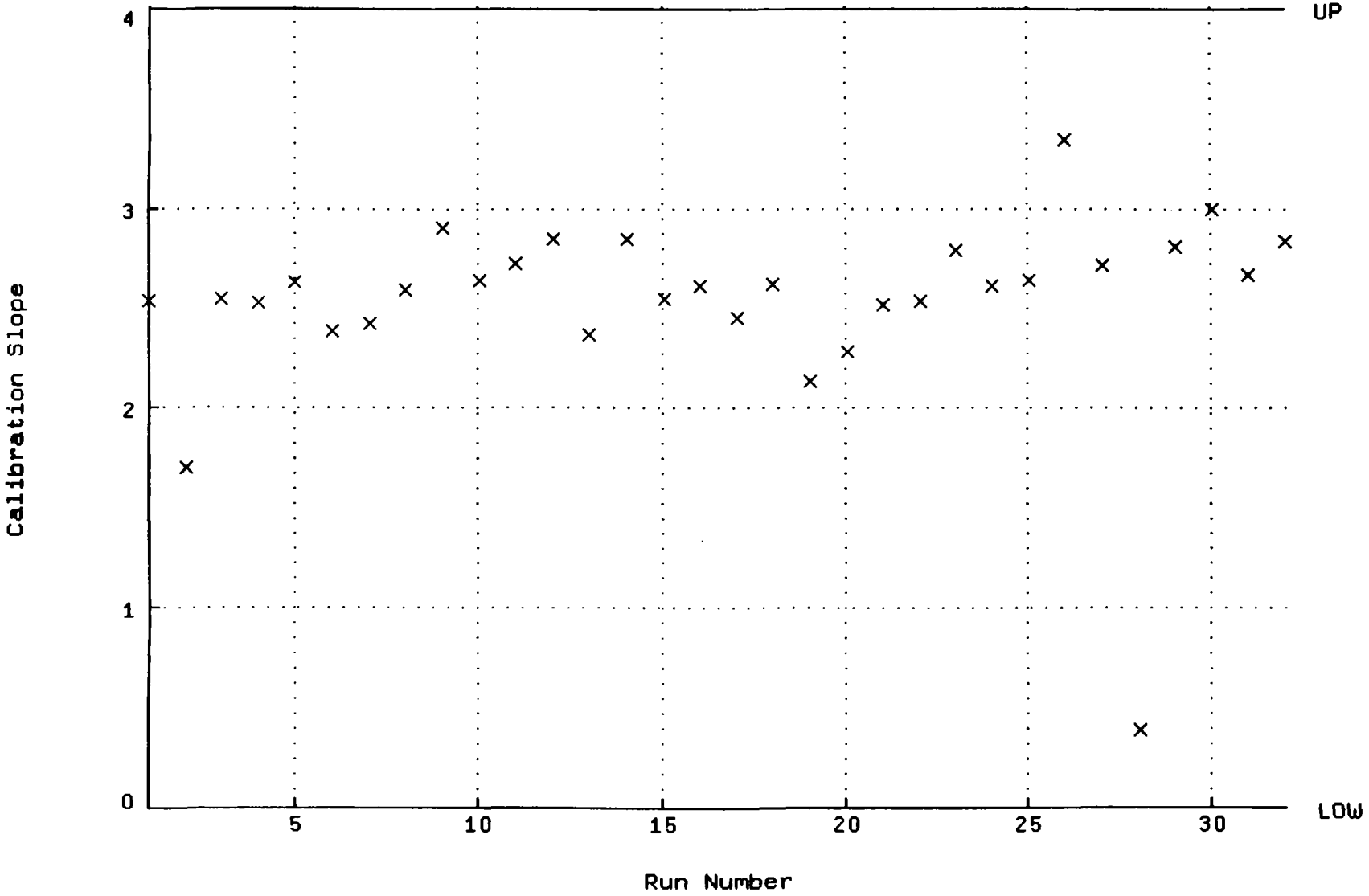
Detector	Parameter	Flag	Filename
1	ALL	Passed	SECOND_001_2oct95
2	ECSLOPE	Below	SECOND_002_2oct95
2	PSENERGY-CM244	Below	SECOND_002_2oct95
3	ALL	Passed	SECOND_003_2oct95
4	ALL	Passed	SECOND_004_2oct95
5	ALL	Passed	SECOND_005_2oct95
6	ALL	Passed	SECOND_006_2oct95
7	ALL	Passed	SECOND_007_2oct95
8	ALL	Passed	SECOND_008_2oct95
9	ALL	Passed	SECOND_009_2oct95
10	ALL	Passed	SECOND_010_2oct95
11	ALL	Passed	SECOND_011_2oct95
12	ALL	Passed	SECOND_012_2oct95
13	ALL	Passed	SECOND_013_2oct95
14	ALL	Passed	SECOND_014_2oct95
15	ALL	Passed	SECOND_015_2oct95
16	ALL	Passed	SECOND_016_2oct95
17	ALL	Passed	SECOND_017_2oct95
18	ALL	Passed	SECOND_018_2oct95
19	ALL	Passed	SECOND_019_2oct95
20	ALL	Passed	SECOND_020_2oct95
21	ALL	Passed	SECOND_021_2oct95
22	ALL	Passed	SECOND_022_2oct95
23	ALL	Passed	SECOND_023_2oct95
24	ALL	Passed	SECOND_024_2oct95
25	ALL	Passed	SECOND_025_2oct95
26	ALL	Passed	SECOND_026_2oct95
27	ALL	Passed	SECOND_027_2oct95
28	ALL	Passed	SECOND_028_2oct95
29	ALL	Passed	SECOND_029_2oct95
30	ALL	Passed	SECOND_030_2oct95
31	ALL	Passed	SECOND_031_2oct95
32	ALL	Passed	SECOND_032_2oct95

APPROVAL DATE: 10-2-95 APPROVAL TIME: 1710

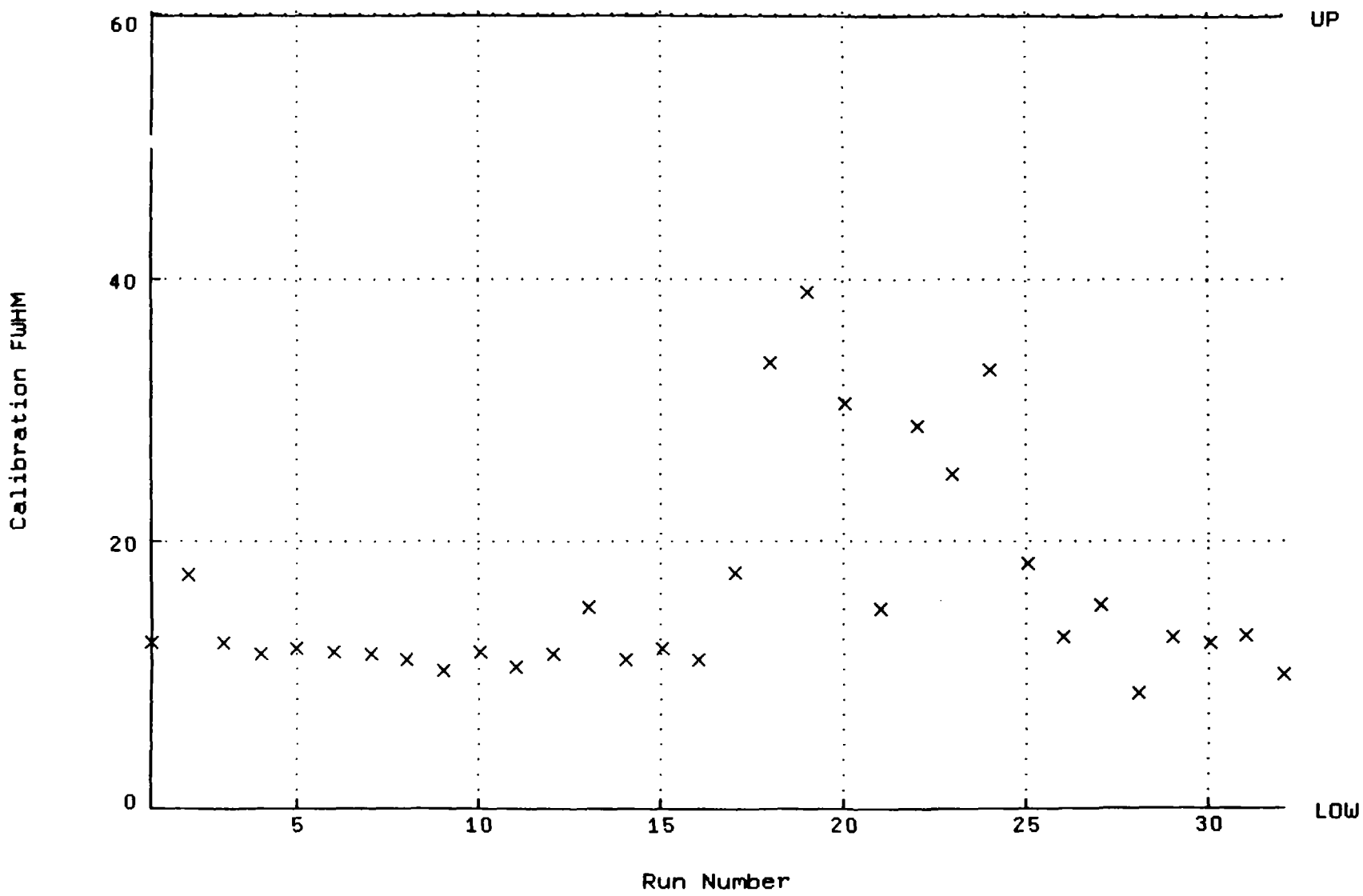
APPROVED BY: [signature] PROCEDURE # NA

Report completed at 2-OCT-1995 12:23:12.93

QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : ECSLOPE (Calibration Slope)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 0.000000E+00 through 4.00000

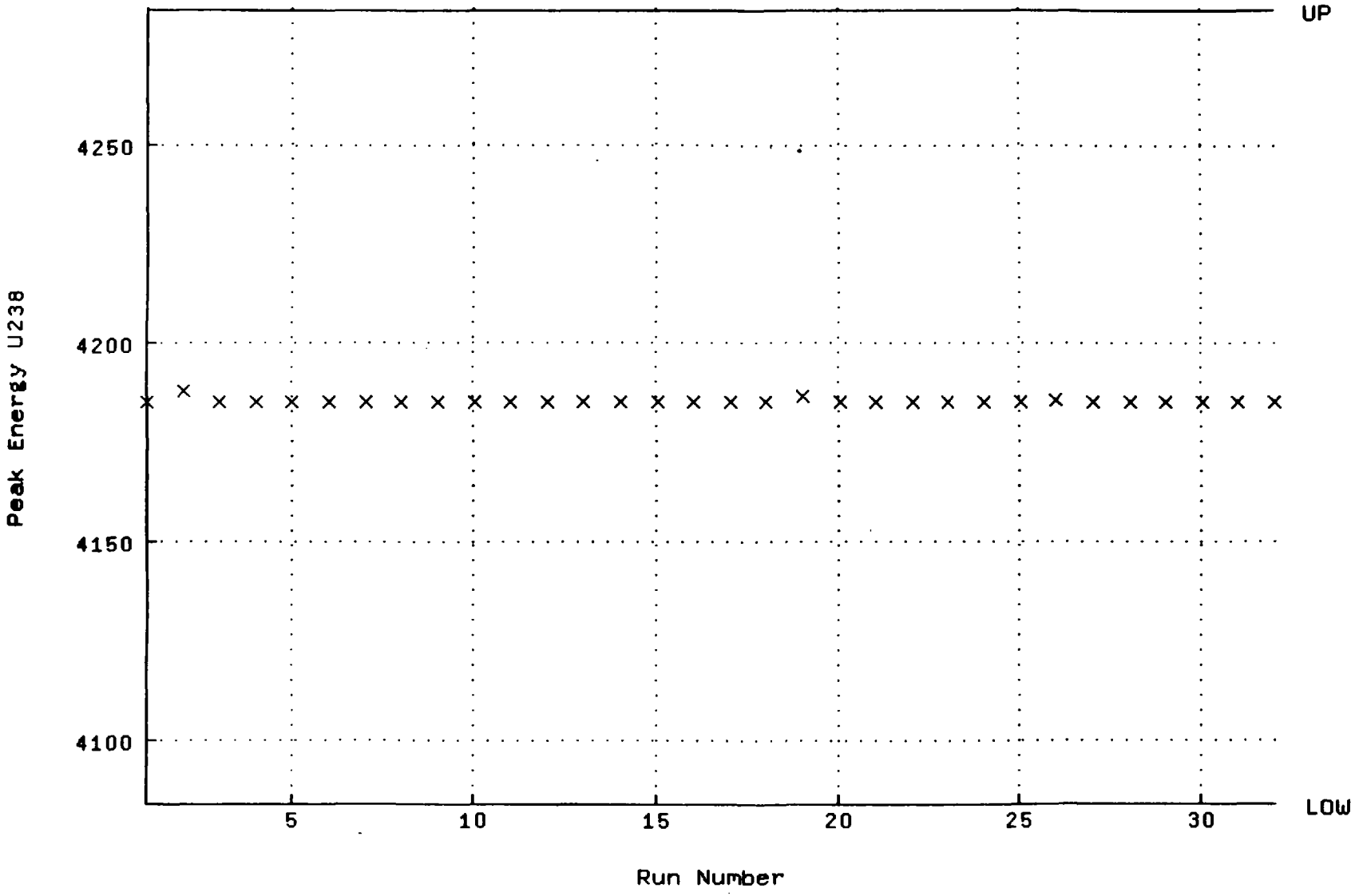


QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : FWHMCONST (Calibration FWHM)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 0.000000E+00 through 60.0000

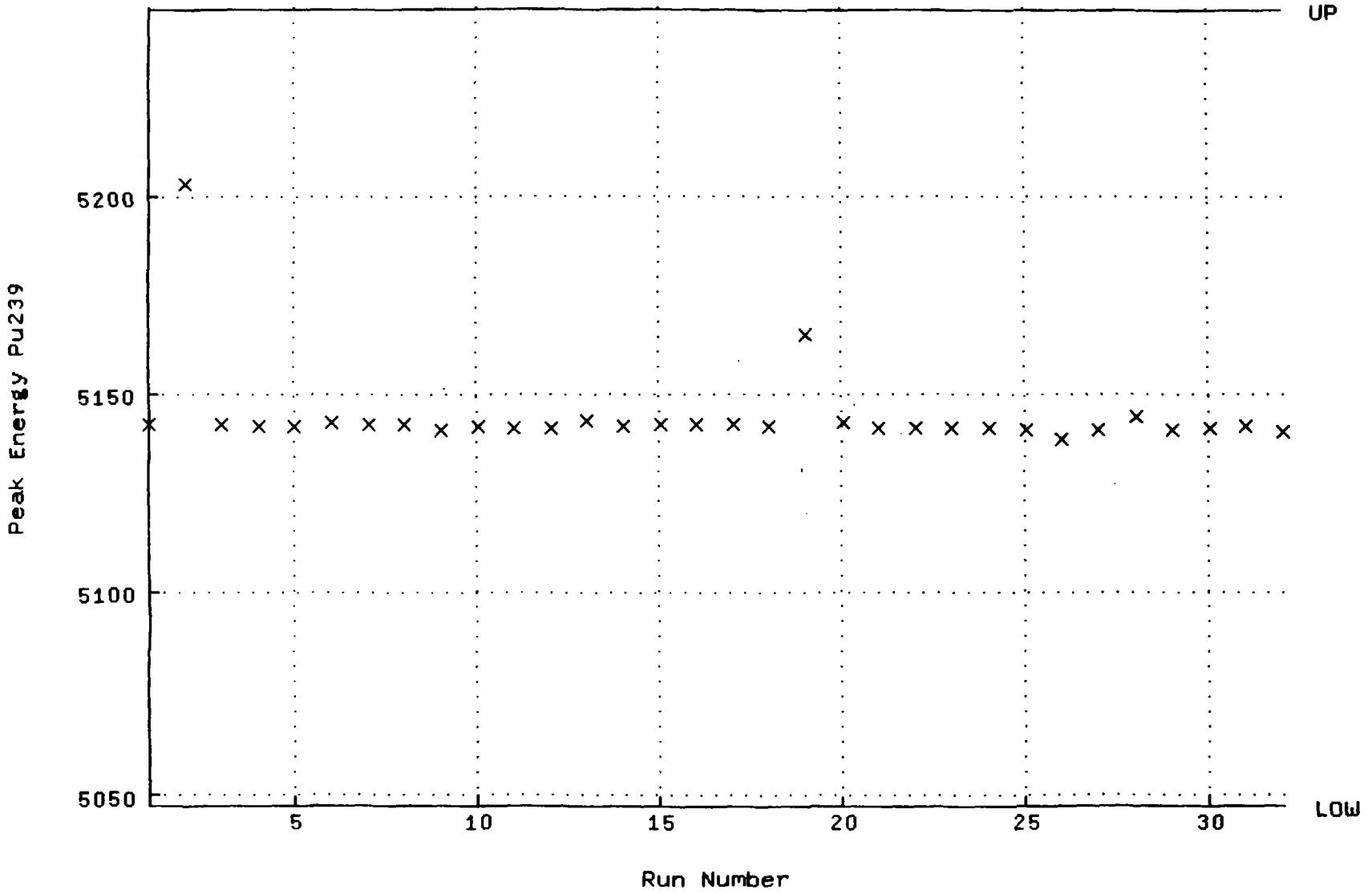


00001.8

QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : PSENERGY-U238 (Peak Energy U238)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 4084.00 through 4284.00

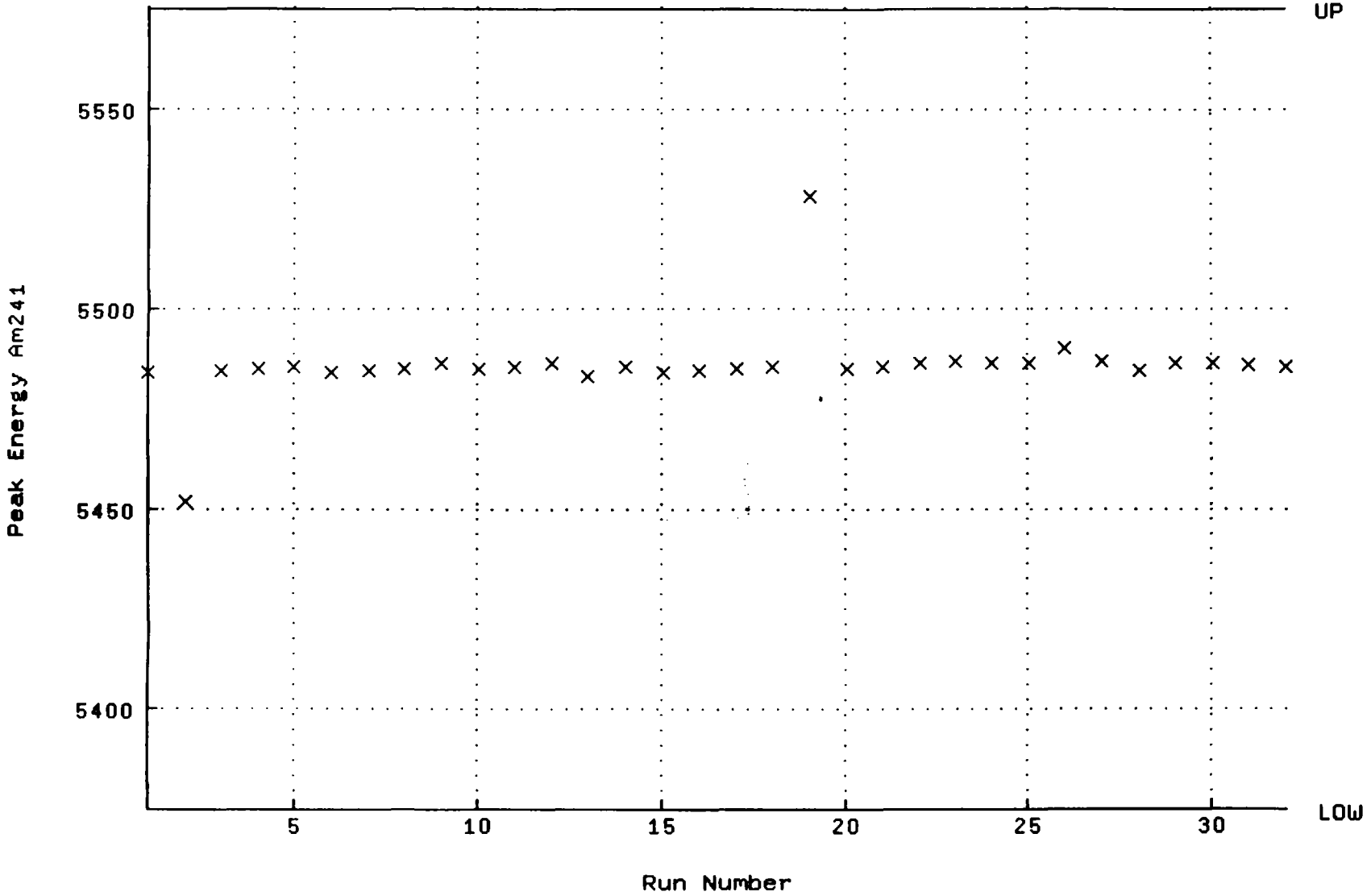


QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : PSENERGY-PU239 (Peak Energy Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 5047.00 through 5247.00



0110090

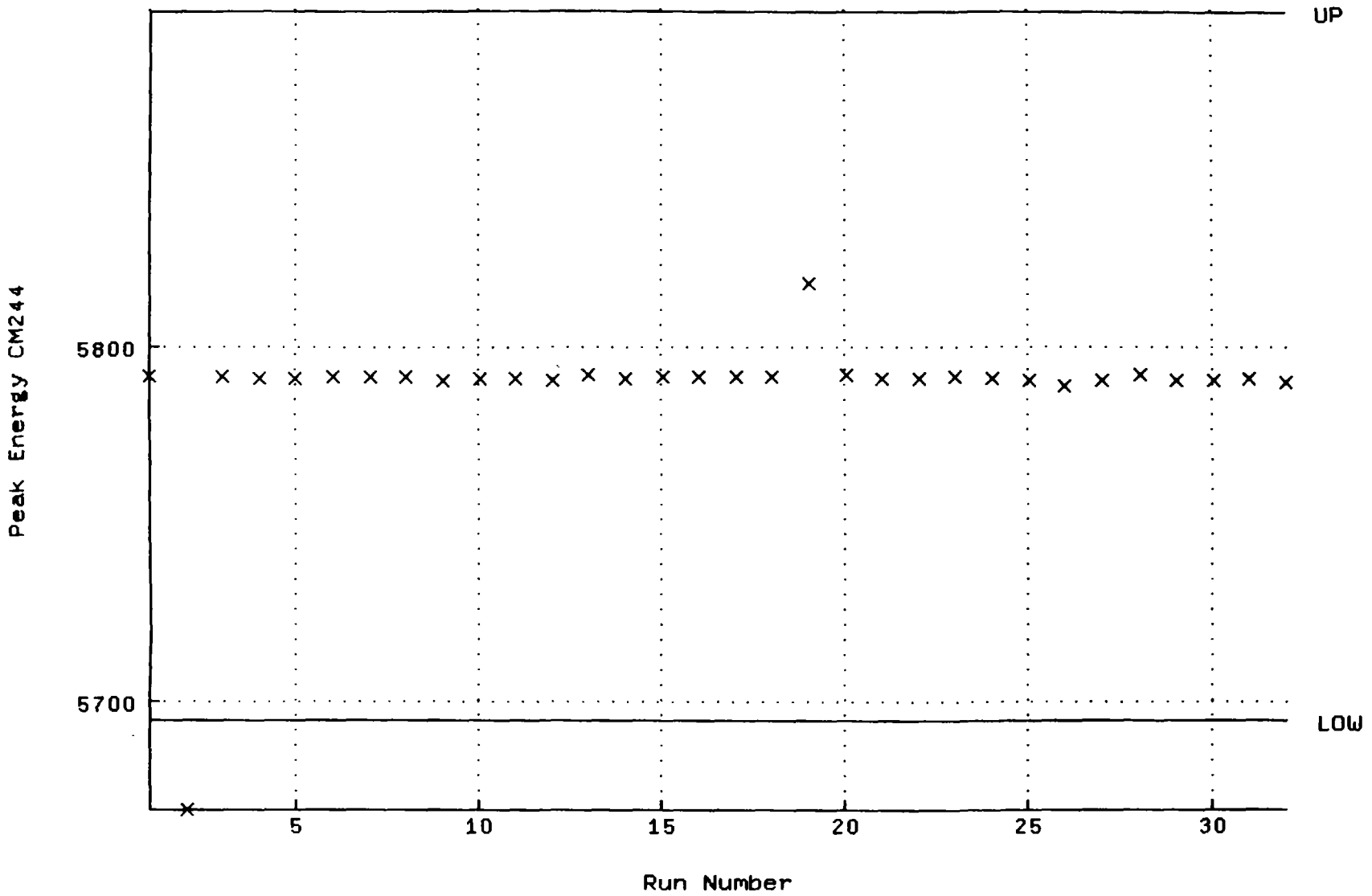
QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : PSENERGY-AM241 (Peak Energy Am241)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 5375.00 through 5575.00



0660111

QA filename : 1DIA3:[ALPHA.ALUSR.QA.SECOND]BATCH_SECOND.QAF;3
Parameter Name : PSENERGY-CM244 (Peak Energy CM244)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 5695.00 through 5895.00

0050112



Review of QA results (Efficiency Calibration Check) 2-OCT-1995 11:52:

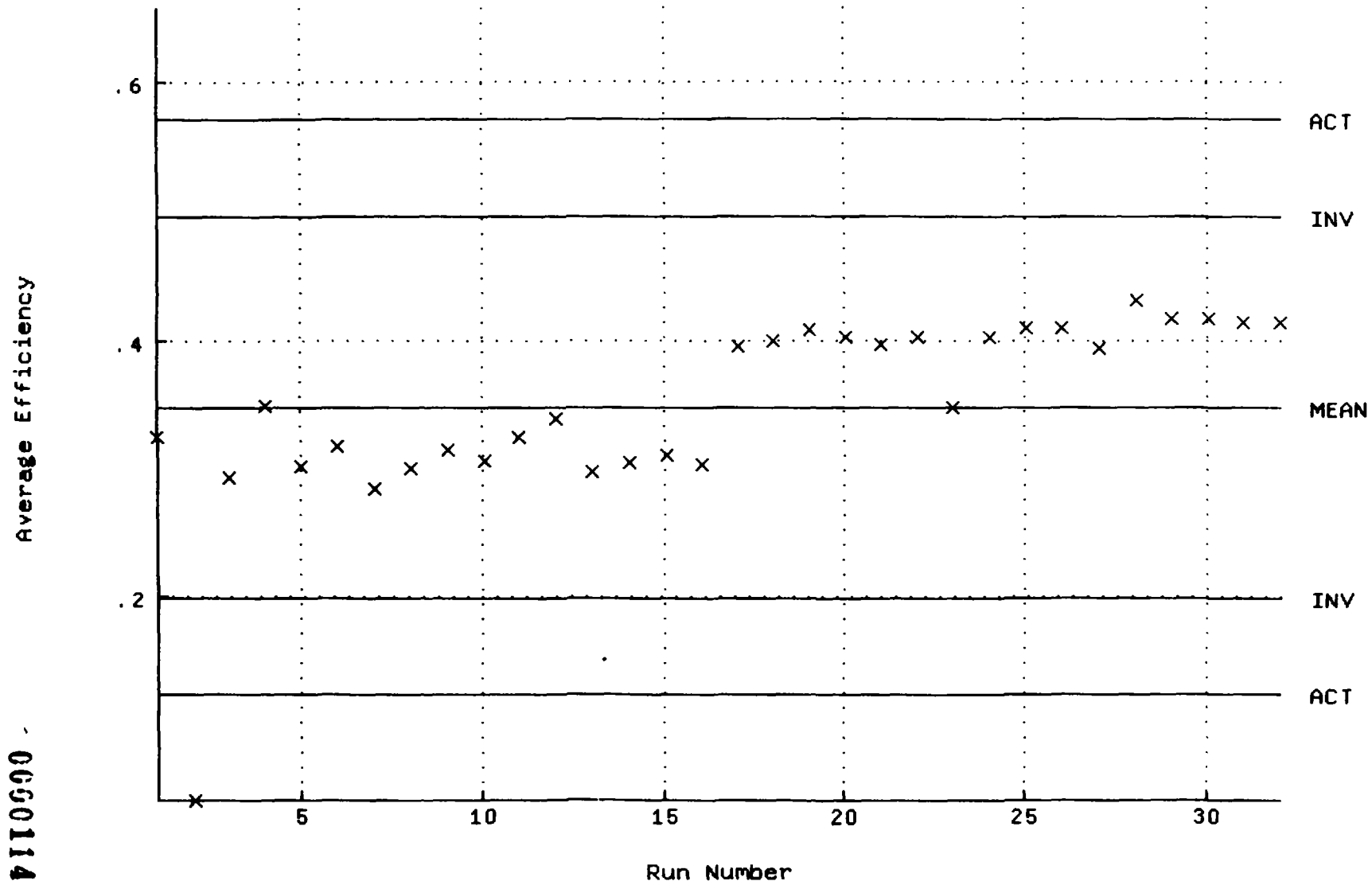
Detector	Parameter	Flag	Filename
1	ALL	Passed	PRIME_001_2oct95
2	PSAREA-PU239	Below	PRIME_002_2oct95
2	AVRGEFF	Action	PRIME_002_2oct95
2	PSFWHM-PU239	Action	PRIME_002_2oct95
3	ALL	Passed	PRIME_003_2oct95
4	AVRGEFF	Action	PRIME_004_2oct95
4	PSFWHM-PU239	Action	PRIME_004_2oct95
5	PSFWHM-PU239	Investigate	PRIME_005_2oct95
6	ALL	Passed	PRIME_006_2oct95
7	ALL	Passed	PRIME_007_2oct95
8	ALL	Passed	PRIME_008_2oct95
9	ALL	Passed	PRIME_009_2oct95
10	ALL	Passed	PRIME_010_2oct95
11	ALL	Passed	PRIME_011_2oct95
12	ALL	Passed	PRIME_012_2oct95
13	ALL	Passed	PRIME_013_2oct95
14	ALL	Passed	PRIME_014_2oct95
15	ALL	Passed	PRIME_015_2oct95
16	ALL	Passed	PRIME_016_2oct95
17	ALL	Passed	PRIME_017_2oct95
18	ALL	Passed	PRIME_018_2oct95
19	ALL	Passed	PRIME_019_2oct95
20	ALL	Passed	PRIME_020_2oct95
21	ALL	Passed	PRIME_021_2oct95
22	PSFWHM-PU239	Investigate	PRIME_022_2oct95
23	ALL	Passed	PRIME_023_2oct95
24	ALL	Passed	PRIME_024_2oct95
25	ALL	Passed	PRIME_025_2oct95
26	ALL	Passed	PRIME_026_2oct95
27	ALL	Passed	PRIME_027_2oct95
28	ALL	Passed	PRIME_028_2oct95
29	ALL	Passed	PRIME_029_2oct95
30	ALL	Passed	PRIME_030_2oct95
31	ALL	Passed	PRIME_031_2oct95
32	ALL	Passed	PRIME_032_2oct95

APPROVAL DATE: 10-2-95 APPROVAL TIME: 1700

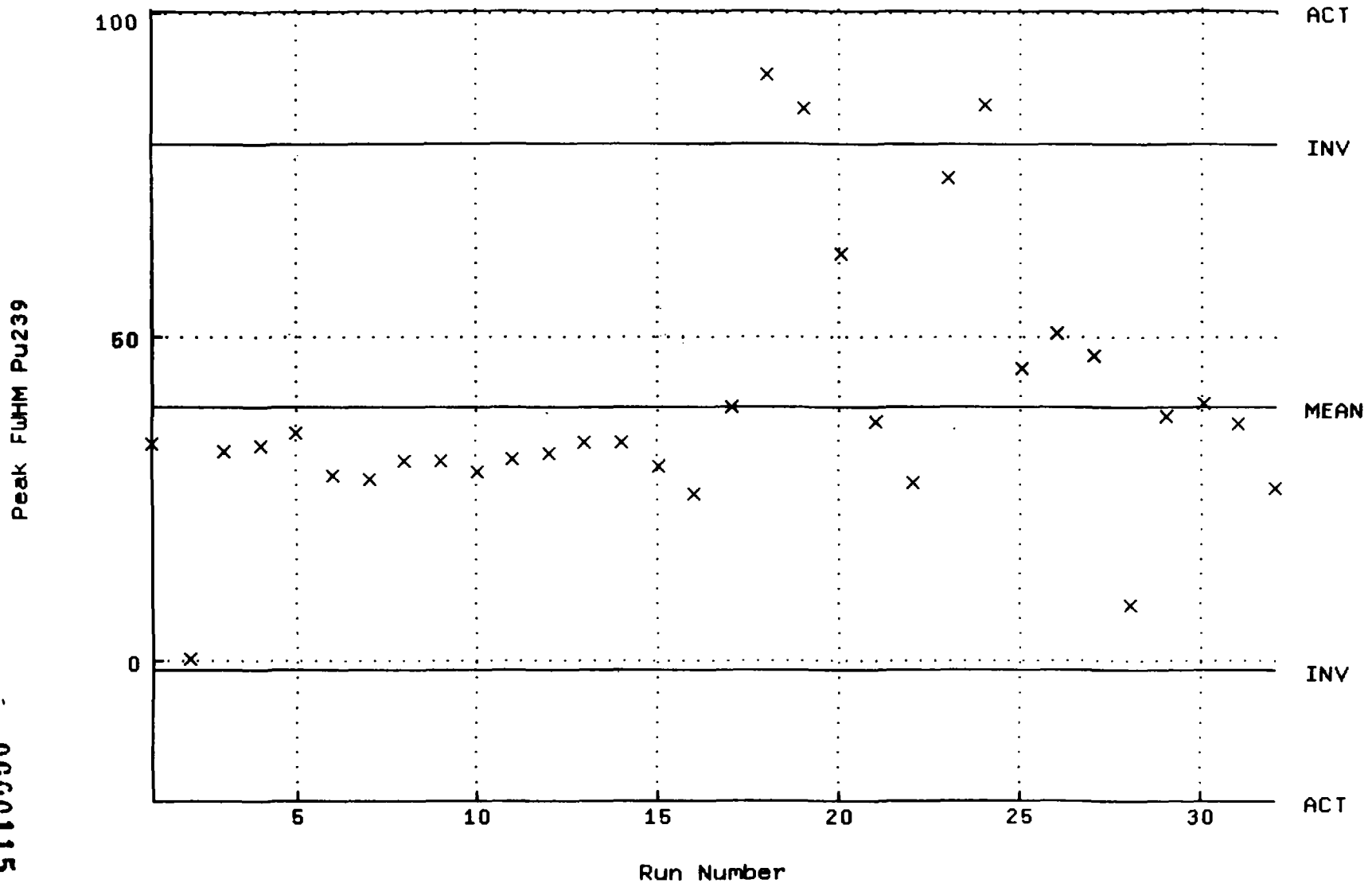
APPROVED BY: [signature] PROCEDURE # NA

Report completed at 2-OCT-1995 11:55:32.90

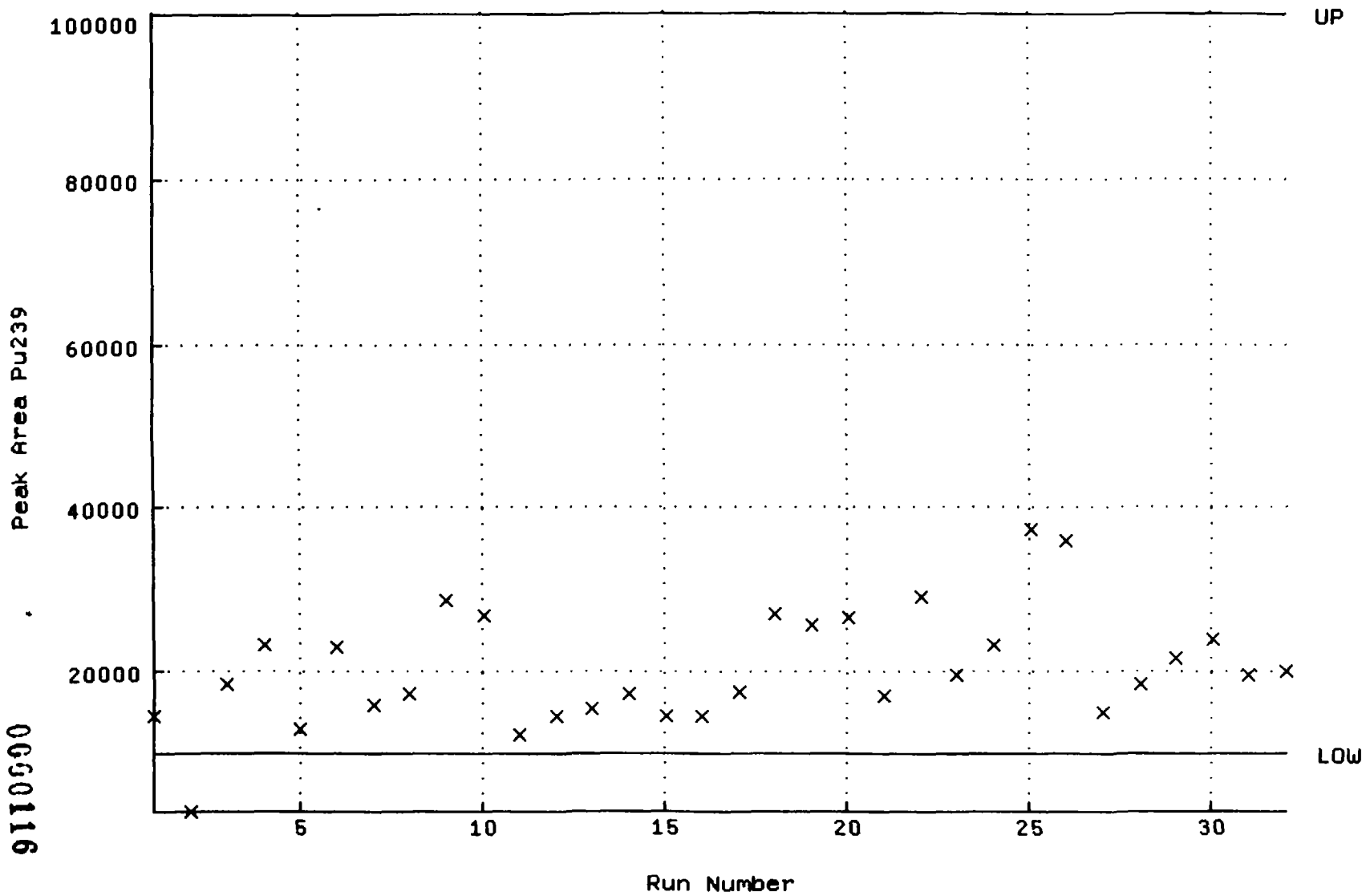
QA filename : 1DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;5
Parameter Name : AVRGEFF (Average Efficiency)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Mean +- Std Dev : 0.348127 +- 7.475668E-02 (21.47 %)



QA filename : 1DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;5
Parameter Name : PSFWHM-PU239 (Peak FWHM Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Mean +- Std Dev : 39.3506 +- 20.3196 (51.64 %)



QA filename : 1DIA3:[ALPHA.ALUSR.QA.PRIME]BATCH_PRIME.QAF;5
Parameter Name : PSAREA-PU239 (Peak Area Pu239)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: 10000.0 through 100000.



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MONTHLY BACKGROUND

ALSPIC4.DOC

0000117

Review of QA results (Backgrounds UU) 2-OCT-1995 08:34:50.28

Detector	Parameter	Flag	Filename
1	ALL	Passed	B_001_29sep95
2	ALL	Passed	B_002_29sep95
3	ALL	Passed	B_003_29sep95
4	ALL	Passed	B_004_29sep95
5	ALL	Passed	B_005_29sep95
6	ALL	Passed	B_006_29sep95
7	ALL	Passed	B_007_29sep95
8	ALL	Passed	B_008_29sep95
9	ALL	Passed	B_009_29sep95
10	ALL	Passed	B_010_29sep95
11	ALL	Passed	B_011_29sep95
12	ALL	Passed	B_012_29sep95
13	ALL	Passed	B_013_29sep95
14	ALL	Passed	B_014_29sep95
15	ALL	Passed	B_015_29sep95
16	ALL	Passed	B_016_29sep95
17	ALL	Passed	B_017_29sep95
18	ALL	Passed	B_018_29sep95
19	ALL	Passed	B_019_29sep95
20	ALL	Passed	B_020_29sep95
21	ALL	Passed	B_021_29sep95
22	ALL	Passed	B_022_29sep95
23	ALL	Passed	B_023_29sep95
24	ALL	Passed	B_024_29sep95
25	ALL	Passed	B_025_29sep95
26	ALL	Passed	B_026_29sep95
27	ALL	Passed	B_027_29sep95
28	PSCTSS-U234	Above	B_028_29sep95
29	ALL	Passed	B_029_29sep95
30	ALL	Passed	B_030_29sep95
31	ALL	Passed	B_031_29sep95
32	ALL	Passed	B_032_29sep95

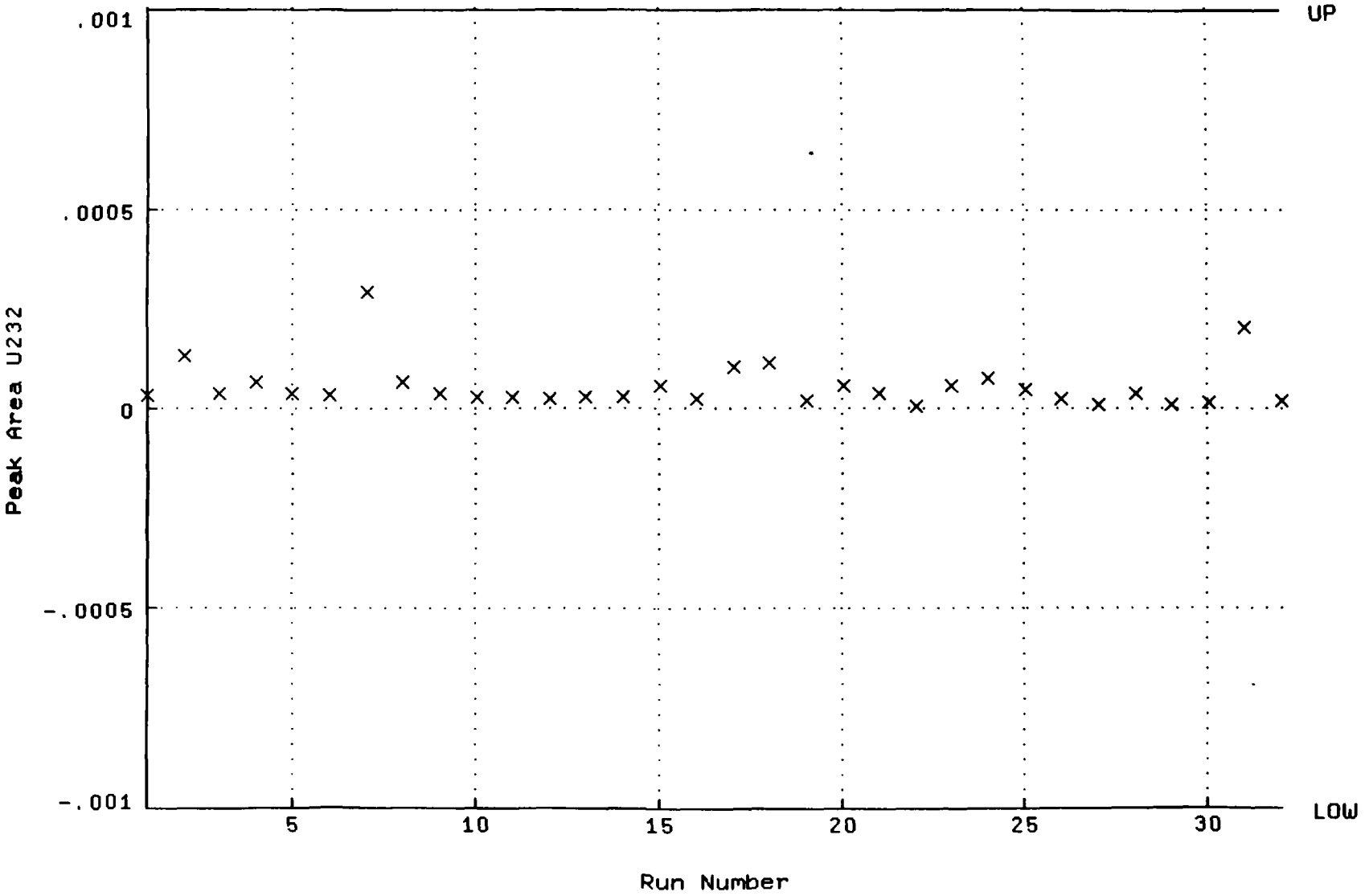
APPROVAL DATE: 10-2-95 APPROVAL TIME: 1730

APPROVED BY: [signature] PROCEDURE # NA

Report completed at 2-OCT-1995 08:37:55.47

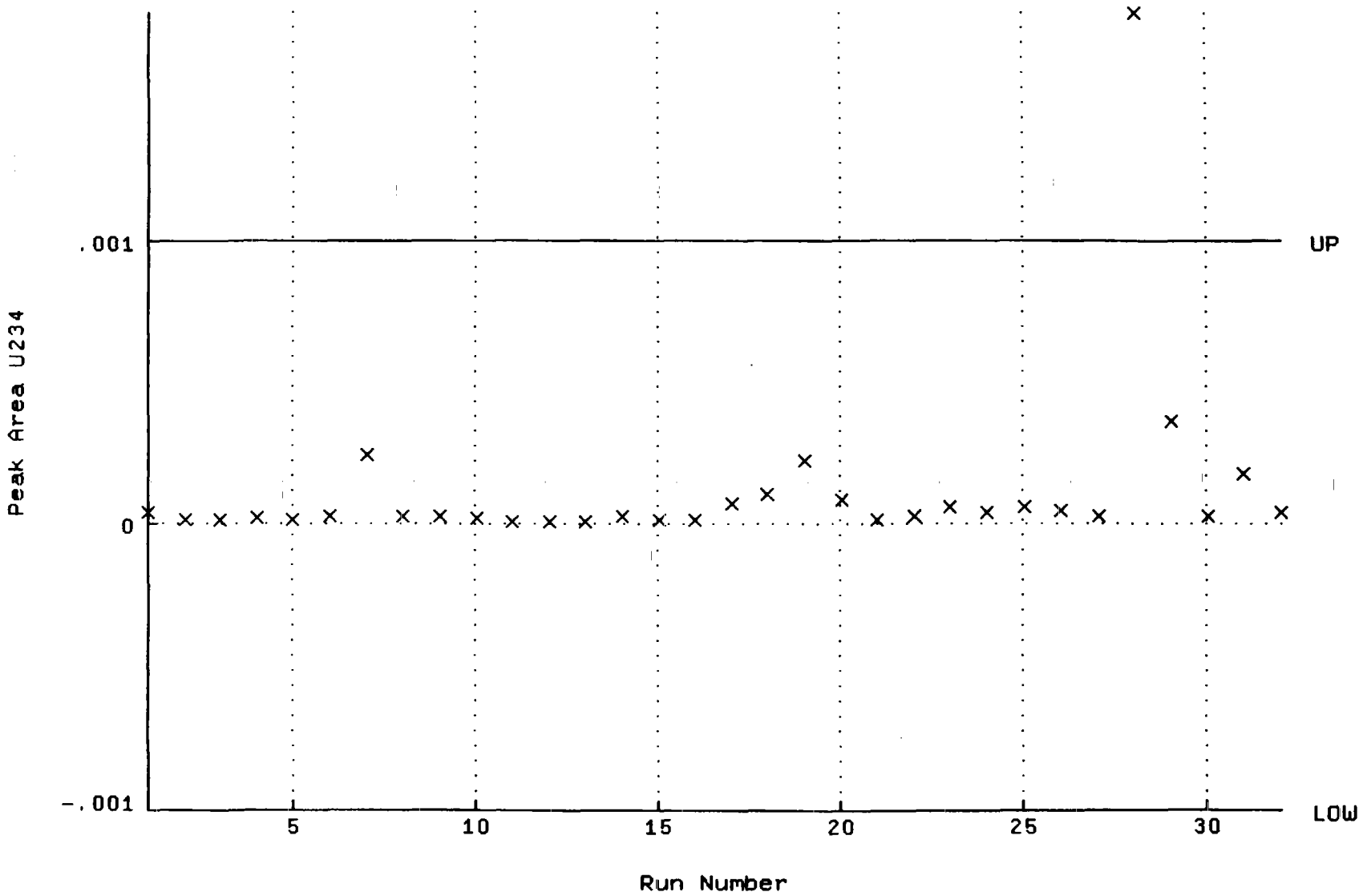
Det 28 to be used for CCS, MS only.

QA filename : 1DIA3:[ALPHA.ALUSR.QA.B]BATCH_B_UU.QAF;1
Parameter Name : PSCTSS-U232 (Peak Area U232)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: -1.000000E-03 through 1.000000E-03

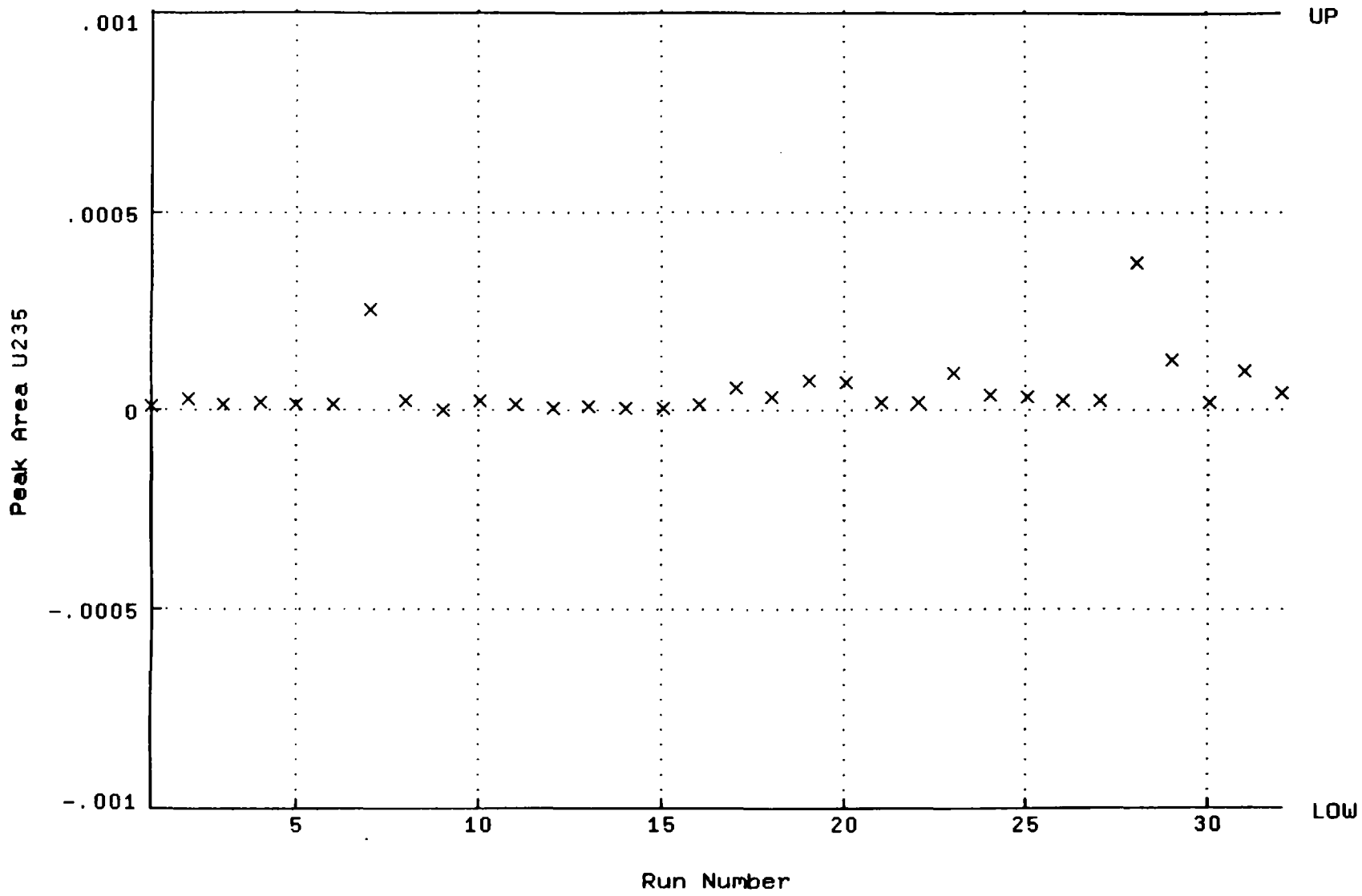


QA filename : 1DIA3:[ALPHA.ALUSR.QA.B]BATCH_B_UU.QAF;1
Parameter Name : PSCTSS-U234 (Peak Area U234)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: -1.000000E-03 through 1.000000E-03

0660120

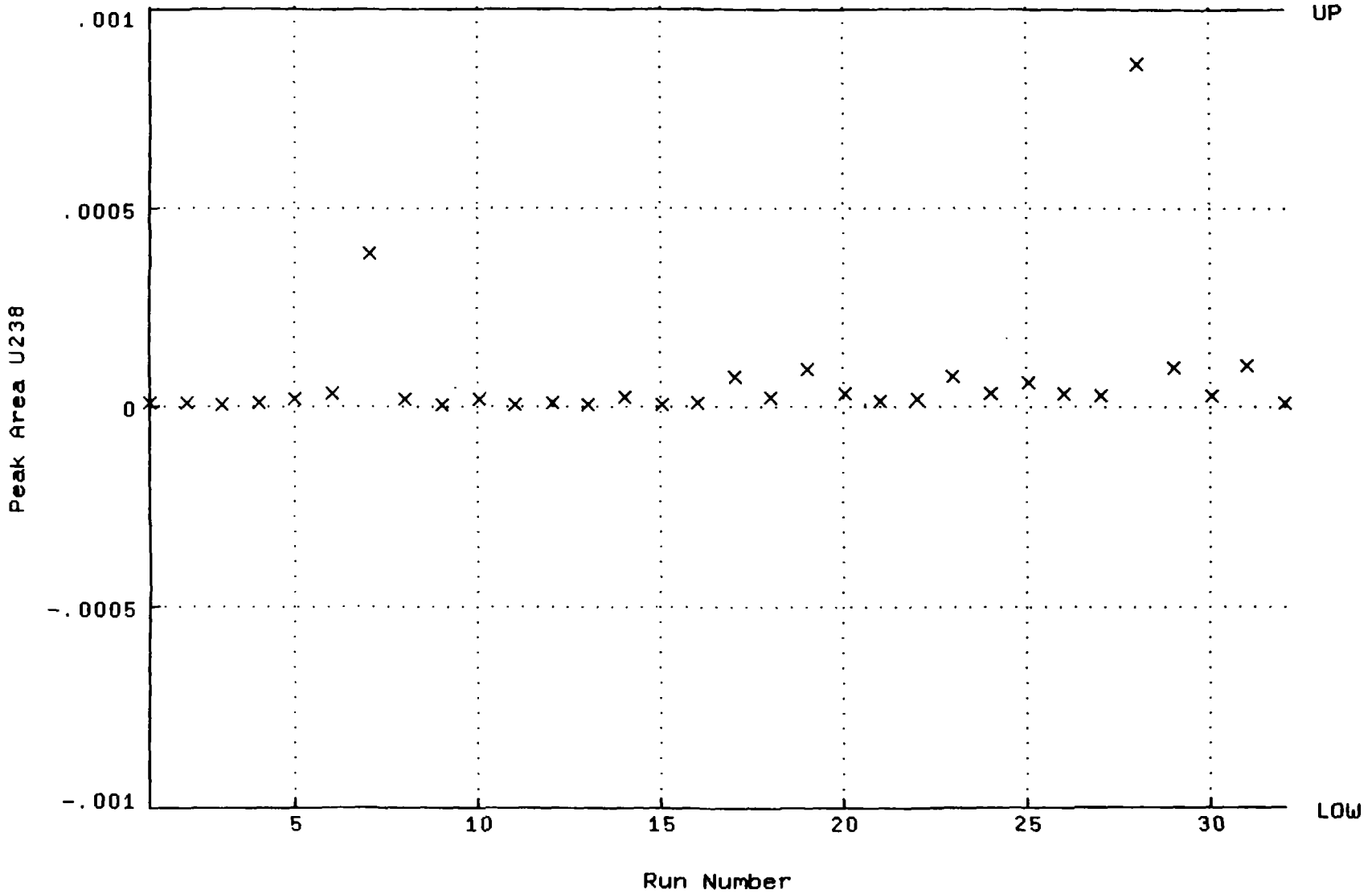


QA filename : 1DIA3:[ALPHA.ALUSR.QA.B]BATCH_B_UU.QAF;1
Parameter Name : PSCTSS-U235 (Peak Area U235)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: -1.000000E-03 through 1.000000E-03



0000121

QA filename : 1DIA3:[ALPHA.ALUSR.QA.B]BATCH_B_UU.QAF;1
Parameter Name : PSCTSS-U238 (Peak Area U238)
Start/End Dates : 1-JAN-1994 00:01:01 through 1-JAN-1994 00:02:16
Lower/Upper Lmts: -1.000000E-03 through 1.000000E-03



00901132

Quanterra
Environmental
Services

BATCH SUMMARY SHEETS

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RUN LOG

VMS Quality Assurance Report V1.3 Generated 3-OCT-1995 09:07:45

QA filename : 1DIA3:[ALPHA.ALUSR.QA.Y]78772_Y_UU_SOIL.QAF;1

Parameter Name	: NCLSP1-U232		
Description	: Yield U232		
Parameter Units	: %	Parameter Type	: CONFIGURATION
Num Points Used	: 8	Num Records Read	: 8
Start Date	: 3-OCT-1995 06:49:30	End Date	: 3-OCT-1995 06:49:30
Minimum Value	: 28.1041	Minimum Date	: 3-OCT-1995 06:49:30
Maximum Value	: 57.3432	Maximum Date	: 3-OCT-1995 06:49:30
Out-of-range Test	: BOUNDARY	Test Source	: PARAMETER-DEPENDENT
Lower Limit	: 20	Upper Limit	: 110

Measurement Time	Sample ID	Value	Flags
3-OCT-1995 06:49:30	LCS	57.3432	
3-OCT-1995 06:49:30	BLK	56.9984	
3-OCT-1995 06:49:30	9369-001	42.2519	
3-OCT-1995 06:49:30	9369-001MS	33.4352	
3-OCT-1995 06:49:30	9369-001MSD	44.0689	
3-OCT-1995 06:49:30	9369-002	28.7704	
3-OCT-1995 06:49:30	9369-003	28.1041	
3-OCT-1995 06:49:30	9369-004	28.2870	

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YIELD SUMMARY

Review of QA results (Tracer Yields/FWHM) 3-OCT-1995 09:07:50.47

Detector	Parameter	Flag	Filename
3	ALL	Passed	R_78772$BLK_UU
1	ALL	Passed	C_78772$LCS_UU
7	ALL	Passed	S_78772$9369-001MSD_UU
6	ALL	Passed	S_78772$9369-001MS_UU
5	ALL	Passed	S_78772$9369-001_UU
8	ALL	Passed	S_78772$9369-002_UU
9	ALL	Passed	S_78772$9369-003_UU
10	ALL	Passed	S_78772$9369-004_UU

ND_AMS_QA_Y:78772_Y_UU_SOIL.QAF

APPROVAL DATE: 10-3-95 APPROVAL TIME: 1030

APPROVED BY: [signature] PROCEDURE # 13007

Report completed at 3-OCT-1995 09:08:39.87

0000127

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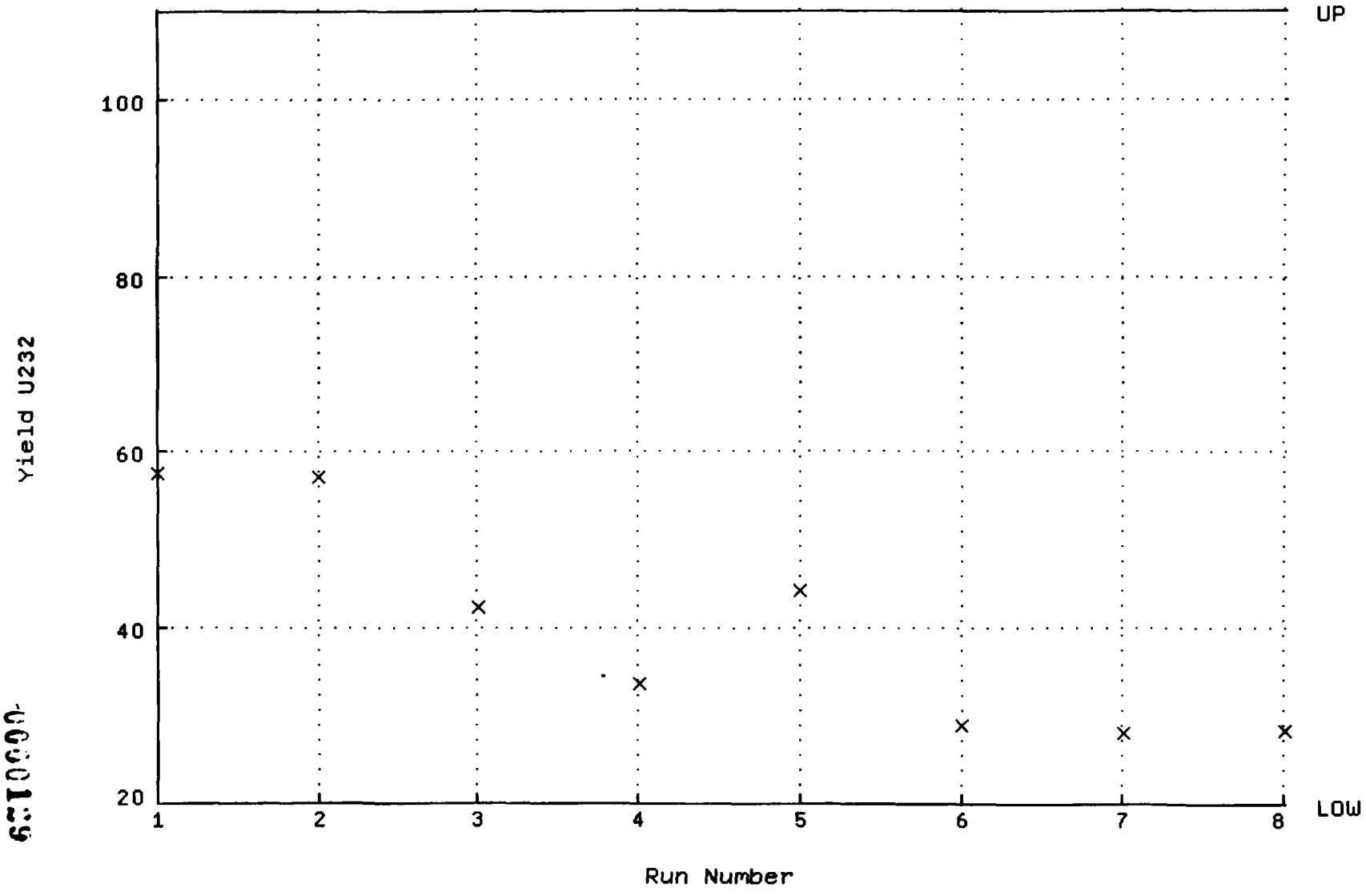
BATCH YIELD PLOT

ALSPBS4.DOC

0000128

QA filename : 1DIA3:[ALPHA.ALUSR.QA.Y]78772_Y_UU_SOIL.QAF;1
Parameter Name : NCLSP1-U232 (Yield U232)
Start/End Dates : 3-OCT-1995 06:49:30 through 3-OCT-1995 06:49:30
Lower/Upper Lmts: 20.0000 through 110.000



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RAW DATA

Quanterra
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PREP DATA SHEET

Quanterra Environmental Services

St.Louis Laboratory
13715 Rider Trail North
Earth City, MO 63045-1205

Isotopic Uranium Analysis

Batch No. : 78772
Project No. : 578.03

Prep Date 09-27-95

	Sample Number	Aliquot (g/L)	Tracer Added	Tracer Verified	Spike Added	Spike Verified	Container Emptied
1	LCS - 78772	1.0000	KS	KS	KS	KS	N/A
2	BLK - 78772	↓			NO	NO	↓
3	9369-001	1.0262			↓	↓	NO
4	-001MS	1.0211			KS	KS	
5	-001MSD	1.0100			↓	↓	
6	-002	1.0246			NO	NO	
7	-003	1.0431			↓	↓	
8	-004	1.0085	↓	↓	↓	↓	↓
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

10-02-95

Tracer

Isotope :	U232
Std Sol'n No. :	588-37A-1B
Vol (mL) :	1.0
Ref Activity (~~pCi/mL~~) :	22.82 dpm/g
Act Ref Date :	04-01-92

Standard

Isotope :	U234/U238	U235	NA
Std Sol'n No. :	1843-1B		NA
Vol (mL) :	1.0		NA
Ref Activity (~~pCi/mL~~) :	12.045 dpm/g		NA
Act Ref Date :	05-1985		NA

Comments:

Prepared By : KS
Date : 10-02-95

Reviewed and received by:
Date : 10-03-95

00001132

ISOU03.XLS Rev 3 (7/94)

Quanterra
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Services

QC ACCEPTANCE SHEETS

VMS Quality Assurance Report V1.3 Generated 3-OCT-1995 08:55:45

QA filename : 1DIA3:[ALPHA.ALUSR.QA.C]BATCH_C_UU_SOIL.QAF;1

Sample ID : LCS Sample quantity : 1.00 gram
Sample date : 3-OCT-1995 00:00:00 Acquisition date : 3-OCT-1995 06:49:30
Elapsed live time: 0 01:39:48.99 Elapsed real time: 0 01:39:48.99

Out-of-range Test: N-SIGMA

Parameter Description [Mean+/-Stdev]	Value	Deviation	Flag
*Control Bias U238 [0.36+/-0.12]	0.46	0.75	
*Control Bias U234 [0.35+/-0.12]	0.26	-0.73	

Flags: "*" means the out-of-range test is parameter-dependent

Approved by: _____ Approval Date: 10 / 3 / 95

	LCS Spike	%Rec
^{238}U	5.437 Ci/g	146%
^{234}U	↓	126%

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LCS STANDARD SHEETS

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: NATURAL URANIUM — Half-life: 4.5×10^9 years

Nominal activity: 11 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 1843-1

Measurement Activity of principal radionuclide

Activity per gram of this solution: 1.07 nano curies of Uranium-238 at 0400 hours PST on May 1989

*Accompanied by 49 picoCuries of Uranium-235 per gram of solution.

Activity of daughter radionuclide

The principal activity was reassessed at the quoted time by: 1.07 nano curies per gram

of the daughter nuclides Th-234, Pa-234, and U-234 assuming secular equilibrium.

Total mass of this solution: APPROX. 5.0 grams

Method of measurement

The solution was prepared gravimetrically by dissolving a known quantity of the National Bureau of Standards' SRM 950b which was 99.97 ± 0.02 percent Uranium Oxide (U_3O_8) in Nitric acid and diluting to a known weight. Natural Uranium was assumed to consist of 99.28 percent U-238 and 0.711 percent U-235 with specific activities of 3.36×10^2 and 2.16×10^3 nanoCuries per gram respectively.

Useful Life

This radionuclide has decayed through [ ] half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after INDEFINITE

0000136

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
GAITHERSBURG, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Uranium-238
Source identification	1843-1, prepared by EMSL
Source description	Liquid in 5-ml flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Natural uranium in 0.6-molar nitric acid
Reference time	0700 EST, 15 May 1989

	NBS DATA	EMSL DATA
Radioactivity concentration	40.05 Bq g^{-1}	39.6 Bq g^{-1}
Overall uncertainty	1.47 percent(1)*	5.0 percent(2)
Photon-emitting impurities (Activities at reference time)	None detected(3)	None detected(4)
Measuring instrument	$4\pi\gamma$ liquid-scintillation counter calibrated using NBS SRM 4321 natural uranium solution	Quantitative dissolutio of NBS SRM 950b natural uranium oxide
Half life	^{238}U : (4.468 ± 0.005) x 10^9 years(5) ^{234}Th: 24.10 ± 0.03 days ^{234}Pa: 6.70 ± 0.05 hours ^{234}U : (2.454 ± 0.006) x 10^5 years	
Difference from NBS		-1.16 percent(6)

For the Director,

Orlie D. Hoppes, Group Leader
Radioactivity Group
Center for Radiation Research

Gaithersburg, MD 20899
19 September 1989

*Notes on next page

0000137

NOTES

(1) Individual uncertainties have the significance of one standard deviation of the mean, or an approximation thereof. The combined uncertainty is the individual uncertainties shown below added in quadrature. The overall uncertainty is taken to be three times the combined uncertainty.

Source of uncertainty	Uncertainty (%)
a) liquid-scintillation measurements	0.12
b) gravimetric measurements	0.05
c) deadtime	0.05
d) background	0.10
e) original calibration of SRM 4321	0.13
f) count-rate-vs-energy extrapolation to zero energy	0.11
g) half life	0.00
h) photon-emitting impurities	0.43
Combined uncertainty	0.49
	* 3
Overall uncertainty	1.47

(2) Overall uncertainty reported by EMSL.

(3) The limit of detection for photon-emitting impurities is 0.01 $\gamma s^{-1} g^{-1}$ for energies between 90 and 1900 keV , provided that the impurity photons are separated in energy by 5 keV or more from photons emitted in the decay of uranium-235 and uranium-238 and progeny.

(4) The limit of detection for ^{226}Ra is less than 0.24 Bq g^{-1}.

(5) Proposed Recommended List of Heavy Element Radionuclide Decay Data, IAEC(NDS)-149/NE, International Atomic Energy Agency, December 1983.

(6) This result demonstrates the traceability of EMSL to NBS, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NBS interagency agreement of April 1976, as amended.

For further information call Larry Lucas at (301) 975-5546 or FTS 879-5546.

$$A = \lambda N \qquad \lambda = \frac{-\ln(0.5)}{T_{1/2}}$$

$$\frac{\text{Wt of U-238}}{\text{g soln}} = \frac{(N)(AW)}{Ao} = \frac{(A)(AW)}{(\lambda)(Ao)} = \frac{(A)(AW)(T_{1/2})}{-\ln(0.5)(Ao)}$$

$$\frac{(40.05)(238\ g)(4.468\ E09\ yr)(3.154E07\ sec/yr)}{(sec*g)\ (mol)\quad (-\ln(0.5))\quad (6.023E23/mol)} = \frac{(3.22\ E\text{-}03\ g)}{g\ soln}$$

$$= \frac{3.22\ mg\ U\text{-}238}{g\ soln} * \frac{1}{0.9928} = \frac{\mathbf{3.24\ mg\ U\ nat}}{\mathbf{g\ soln}}$$

A = Activity (sec^{-1})

λ = Decay constant (sec^{-1})

$T_{1/2}$ = Halflife (sec)

N = Number of atoms

AW = Atomic weight

Ao = Avogadro's number ($mols^{-1}$)

NATURAL URANIUM STD FROM Log Book 356 ON PG #26. STD #. 1843-1-2. Concentration of 240 dpm/ml was Counted & ng/ml The STD Dilutions For KPA are Listed Below

$$\left(\frac{240.0\ dpm}{1\ ml} \times \frac{1\ uCi}{2.22E^{6}\ dpm} \times \frac{1.0\ g}{3.37E^{-7}\ uCi}\right) = 3.21E^{-4}\ g/ml = 3.21E5\ ng/ml$$

$3.2\,E5 \times \frac{1.0\,ml}{100\,ml} = 3210$ ng/ml TOTAL U # 1843-1-3A

$3210 \times \frac{6.3\,ml}{100\,ml} = 202$ ng/ml TOTAL U # 1843-1-3B

$3210 \times \frac{4.7\,ml}{100\,ml} = 150.9$ ng/ml TOTAL U # 1843-1-3C

$3210 \times \frac{3.1\,ml}{100\,ml} = 99.5$ ng/ml TOTAL U # 1843-1-3D

$3210 \times \frac{1.6\,ml}{100\,ml} = 51.4$ ng/ml TOTAL U # 1843-1-3E

$202.2 \times \frac{5.0\,ml}{100\,ml} = 10.1$ ng/ml TOTAL U # 1843-1-3F

$202.2 \times \frac{3.5\,ml}{100\,ml} = 7.1$ ng/ml TOTAL U # 1843-1-3G

$202.2 \times \frac{2.5\,ml}{100\,ml} = 5.1$ ng/ml TOTAL U # 1843-1-3H

$2.022 \times \frac{1.0\,ml}{100\,ml} = 2.0$ ng/ml TOTAL U 1843-1-3I

$10.1 \times \frac{10.0}{100\,ml} = 1.0$ ng/ml TOTAL U 1843-1-3J

07-08-94

Continued on Page

Read and Understood By

0000140

Signed — Date: 07-02-94

07-08-94 A.C. Valentine — Signed — Date: 07-08-94

Obtained U-238 (Natural U) from ERA-LV activity concentration of 1.07 nCi/g. Reference date: May 1989

The half life for U-238 is 4.468E9 years. There is no significant decay correction at this time.

Gross wt.	42.7086 g
Tare wt.	37.6556 g
Amount transferred	5.0530 g

$$\frac{\left(1.07 \frac{nCi}{g}\right)(5.053\ g)\left(\frac{2.22E9\ dpm}{nCi}\right)}{50\ mL\ (1\ mL/s)} \cdot 240.06 \frac{dpm}{pCi} \text{ U-238 \# 1843-1-2 as of May 1989}$$

M. Baughn 02-11-93

Continued on Page

Read and Understood By

M. Baughn — 02-11-93 — Signed / Date

B. Twins — 2-17-93 — Signed / Date

00001141

Notebook No. 5W

:CT Natural Uranium #1845-1

Continued From Page

FF EMSLV

Natural uranium solution obtained through EMSLV was prepared as described below.

42.6737 g. Wt of flask plus standard sol'n
37.5447 g. Wt of flask
5.0691 g. Amount transferred

nCi / gram	%
1.09 U-238	48.9
1.09 U-234	48.9
0.049 U-235	2.2

Σ = 2.189 nCi/g.

$\left(\frac{2.189\ nCi}{g}\right)\left(5.0691\ g\right)\left(\frac{2.22 E3\ dpm}{nCi}\right) =$ 492.9 dpm/ml Total U. #1845-1

50 ml. 1 N HNO_3

Note: Total U contains Following isotopes:

U238 492.7 * 0.489 = 240.9 dpm

U234 492.7 * 0.489 = 240.9 dpm

B.E. Thomas
2-23-93

R. Patterson 09-23-92

Continued on Page

00000142

Read and Understood By

Signed	Date	Signed	Date
U Faudree	09-21-92	R. Patterson	09-23-92

PROJECT Natural U Solution #1843-1B

Continued From Page

Natural Uranium Solution obtained from EMSL with an activity concentration of 2.69 nCi/g was given Std. Soln # 1843-1.

References: From Std. Lot Book #356, pg. 9.

A Dilution of Std #1843-1 is shown below.

$$\frac{(492.7\ \text{dpm/ml})(5.0\ \text{ml})}{100.0\ \text{ml}} = 24.64\ \text{dpm/ml}$$

Standard Soln. # 1843-1B Total U

$U_{238} = 12.645$ dpm/ml

$U_{234} = 12.645$ dpm/ml

Continued on Page

Signed

02-27-95
Date

Read and Understood By

Signed

0000143

02-27-95
Date

Quanterra
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TRACER STANDARD SHEET

0000144

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Radionuclide	U-232	Customer:	IT CORPORATION
Half Life:	68.9 ± 1.0 years	P.O.No.:	047870
Catalog No.:	7232-2	Reference Date:	September 1 1991 12:00 PST.
Source No.:	388-37	Contained Radioactivity:	1.039 μCi.

Description of Solution

a. Mass of solution:	5.2693	grams.
b. Chemical form:	UO2Cl2 in 2N HCl	
c. Carrier content:	None added	
d. Solution density:	1.0330	gram/ml @ 20°C.

Radioimpurities

See attached technical data sheet

Radioactive Daughters

See attached technical data sheet

Radionuclide Concentration

0.1974 μCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using alpha spectrometry with a surface barrier detector.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±1.3%
b. Random uncertainty in assay:	±1.0%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±2.3%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)

QUALITY CONTROL

ISOTOPE PRODUCTS LABORATORIES
1800 No. Keystone Street.,
Burbank, California 91504
(818) 843 - 7000

0000145

Isotope Products Laboratories standard # 383-37 was prepared as follows

39.38.28 g wt. of ampule plus beaker
34.62.54 g wt. of empty ampule plus beaker
5.2374 g wt. amount transferred

$$\frac{(5.2372\,g)\left(\frac{[illegible]}{g}\right)\left(2.2286\,\frac{dpm}{\mu Ci}\right)}{50\,ml.\ (1N\ HNO_3)} = 45901.8\,\frac{dpm}{ml.}\ U\text{-}232\ \#\ 383\text{-}37$$

$A = A_0\, e^{-\lambda t}$

$t = 0.583\,yrs$ (04-21-91 to 04-01-92)

$\lambda = 0.693/72\,yrs$

$\lambda t = 0.0056$

$$45901.8\,\frac{dpm}{ml}\ e^{-\left(\frac{0.693}{72\,yrs}\right)(0.583\,yrs)} = 45645\,\frac{dpm}{ml.}\ U\text{-}232\ \text{as of}\ 04\text{-}01\text{-}92 \quad \#\ 383\text{-}37$$

$$\frac{(45645\,\frac{dpm}{ml})(5\,ml)}{50\,ml} = 4564.5\,\frac{dpm}{ml}\ U\text{-}232,\ \#\ 383\text{-}37A$$

$$\frac{(4564.5\,dpm/ml.)(5\,ml)}{50\,ml.} = 456.4\,\frac{dpm}{ml.}\ U\text{-}232\ \#\ 383\text{-}37B$$

$$\frac{(456.4\,\frac{dpm}{ml})(10\,ml.)}{100\,ml.} = 45.6\,\frac{dpm}{ml.}\ U\text{-}232\ \#\ 383\text{-}37B\text{-}1\ \text{in}\ 1N\ HNO_3$$

Continued on Page

Read and Understood By

M. Baughn 04-01-92 B Thim[illegible] [illegible]

ECT U-232 #388-37A-1B

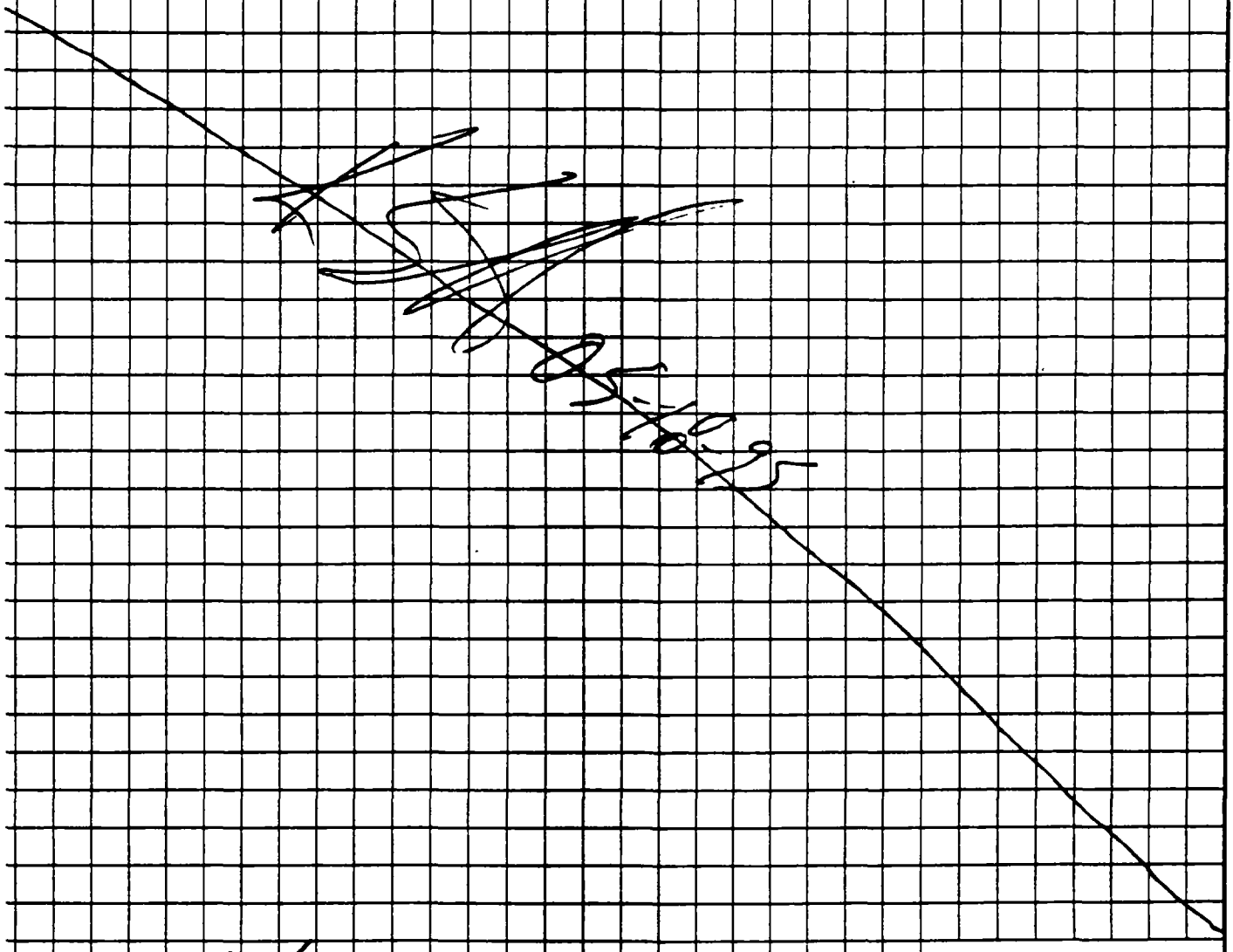
Notebook No. _____

Continued From Page _____

PREPARED FROM U-232 SOLUTION #388-37A WITH A CONCENTRATION OF 4564.5 dpm/ml FROM STANDARD LOG BOOK #43, pg. 92.

$$\frac{(4564.5\ dpm/ml)(2.5\ ml)}{500\ ml} = 22.82\ dpm/ml$$ U-232 AS OF 04-01-92

STD. SOLUTION #388-37A-1B



Continued on Page

Read and Understood By

Signed	Date	Signed	Date
	05-18-95		05-18-95

Quanterra

CHAIN-OF-CUSTODY SHEETS

Quanterra September 28, 1995 03:47 pm
Account: 11111 Project: 578.03 Kerr McGee QAS No. 578.03 Rev. 0
Master Sample Login: 9369

Project Manager: D. Mueller

Draft: Final: Entered and Reviewed by: Kathy A Skrapits Review: Diane W Mueller 9.28.95

Sample Header Template:

Sample No. / Comments	Client ID	C-Matrix	Date: Collected	Received	Due	Shipper	Rad Category	Rad Sample No.
# Container Type / Data:	Analysis	Class	Preservative	Anal. Due Date	Hold Date	Site		(Container Numbers:% Filled)
9369-001	CD-S156E49N-2-3	Soil	22-MAY-94 12:40	24-MAY-94 09:10	04-OCT-95	IN HOUSE	2	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179516:25)
9369-001DUP	CD-S156E49N-2-3	Soil	22-MAY-94 12:40	24-MAY-94 09:10	04-OCT-95	IN HOUSE	2	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179516:25)
9369-001MS	CD-S156E49N-2-3	Soil	22-MAY-94 12:40	24-MAY-94 09:10	04-OCT-95	IN HOUSE	2	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179516:25)
9369-002	CD-S78E18N-2-3	Soil	22-MAY-94 16:00	24-MAY-94 09:10	04-OCT-95	IN HOUSE	3	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179517:25)
9369-003	CD-S81E5N-3-4	Soil	22-MAY-94 15:00	24-MAY-94 09:10	04-OCT-95	IN HOUSE	3	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179518:25)
9369-004	CD-S81E5N-2-3	Soil	22-MAY-94 15:00	24-MAY-94 09:10	04-OCT-95	IN HOUSE	3	Screening not Required
1 AN - Amber Glass-500ml	RAD/ISOU/Q4	S	COLD	02-OCT-95	20-NOV-94	R19D		(179519:25)

3*=Sample has not been rad screened.

Quanterra St. Louis
Isotopic Thorium Analysis

Project: 537.01
Batch: 38993

SAMPLE NUMBER	PREP DATE	ALIQUOT (g)	COUNT DATE	COUNT TIME (MIN)	BKGD TIME (MIN)	DET NO.	EFF.	ROI #1 Th-232	BKGD	ROI #2 Th-230	BKGD	ROI #3 Th-229	BKGD	ROI #4 Th-228	BKGD
LCS 38993	6/7/94	2.0000	6/8/94	200	4000	1	0.310	1018	71	1002	176	777	63	1138	94
BLK 38993	6/7/94	2.0000	6/8/94	200	4000	2	0.317	3	41	106	86	691	43	31	105
5179-001	6/7/94	2.0891	6/8/94	200	4000	3	0.307	58	141	212	208	658	121	86	108
5179-001DUP	6/7/94	2.0208	6/8/94	100	4000	8	0.310	36	62	59	114	389	32	51	102
5179-005	6/7/94	0.0104	6/8/94	200	4000	5	0.311	288	138	228	234	1425	59	334	122
5179-011	6/7/94	0.0101	6/8/94	200	4000	6	0.311	327	153	131	222	967	107	417	127
5179-012	6/7/94	0.0101	6/8/94	200	4000	7	0.308	227	89	105	153	903	59	260	91

TRACER pCi added: 9.01
LCS Th-232 pCi/matrix: 5.15
LCS Th-230 pCi/matrix: 4.20

CALCULATED BY: LEG DATE: 6/27/94

REVIEWED BY: DATE: 6/27/94

INTERNATIONAL TECHNOLOGY CORPORATION

ITAS St. LOUIS
Isotopic Uranium Analysis

PROJ: 537.01

BATCH: 38993

SAMPLE NUMBER	PREP DATE	ALIQUOT (g or l)	COUNT DATE	COUNT TIME	BKGD TIME	DET. NO.	EFF	ROI#1 U-238	BKGD	ROI#2 U-235, U-236	BKGD	ROI#3 U-234	BKGD	ROI#4 U-232	BKGD
LCS 38993	06-07-94	2.0000	06-09-94	100	4000	1	0.310	205	87	9	86	220	93	349	64
BLK 38993	06-07-94	2.0000	06-09-94	100	4000	2	0.317	1	53	1	30	3	75	305	57
5179-001	06-07-94	2.0891	06-09-94	100	4000	3	0.307	12	149	3	112	8	147	22	119
5179-001DUP	06-07-94	2.0208	06-09-94	100	4000	4	0.308	3	56	1	48	8	79	19	111
5179-005	06-07-94	0.0104	06-09-94	100	4000	5	0.311	21	153	7	112	26	102	326	91
5179-011	06-07-94	0.0101	06-09-94	100	4000	6	0.311	20	129	1	130	23	117	321	101
5179-012	06-07-94	0.0101	06-09-94	100	4000	7	0.308	18	80	1	82	21	54	329	69

TRACER pCi added: 10.28
LCS U-238 pCi/matrix : 2.71

CALCULATED BY: LEG DATE: 06/09/94

REVIEWED BY: Donald L Dill DATE 6-9-94

0000002

Quanterra Incorporated
13715 Rider Trail North
Earth City, Missouri 63045

314 298-8566 Telephone
314 298-8757 Fax

Kerr - McGee Corporation
3301 N.W. 150th Street
Oklahoma City, OK 73134

September 25, 1995

ATTENTION: Garet E. Van De Steeg

On May 24, 1994, twelve (12) soil samples were received at Quanterra, St. Louis laboratory (formerly ITAS - St. Louis) from STS Consultants. The original data was reported on June 10, 1994. The following is a list of the samples and the Quanterra (ITAS) identification numbers:

CLIENT ID	QUANTERRA (ITAS) ID
CD-S156E49N-2-3	5179-001
CD-S156E49N-2-3	5179-001DUP
CD-S156E49N-3-4	5179-002
CD-S-82E25N2-3	5179-003
CD-S82E25N-3-4	5179-004
CD-S78E18N-2-3	5179-005
CD-S89E16N-2-3	5179-006
CD-S89E16N-3-4	5179-007
CD-S78E18N-3-4-9	5179-008
CD-S78E18N-3-4	5179-009
CD-S81E5N-2-3-9	5179-010
CD-S81E5N-3-4	5179-011
CD-S81E5N-2-3	5179-012

On September 18, 1995, a request was made by Kerr - McGee and STS Consultants for Quanterra to re - evaluate the data generated for Gamma Spectroscopy analysis regarding the detected Ra^{223} results. The results of this data review of Gamma Spectroscopy analysis by method HASL 300 4.5.2.3 follows in the enclosed Revised Case Narrative and corrected data sheets, which reflect the outcome of this data review. Attached are copies of all correspondence and Conversation Records.

If you have any questions or comments, please call me at (314) 298-8566.

Reviewed and approved:

Diane W. Mueller

Diane W. Mueller
Project Manager

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Earth City Missouri 63045

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REVISED CASE NARRATIVE

September 25, 1995

PURCHASE ORDER NUMBER:	27313-ZH
PROJECT NUMBER:	537.01
DATE RECEIVED BY LAB:	May 24, 1994
NUMBER OF SAMPLES:	Twelve (12)
SAMPLE TYPE(S):	Soil

I. Introduction

On May 24, 1994, twelve (12) soil samples were received at Quanterra, St. Louis laboratory (formerly ITAS) from STS Consultants. The following is a list of the samples and the Quanterra (ITAS) identification:

CLIENT ID	QUANTERRA (ITAS) ID
CD-S156E49N-2-3	5179-001
CD-S156E49N-2-3	5179-001DUP
CD-S156E49N-3-4	5179-002
CD-S-82E25N2-3	5179-003
CD-S82E25N-3-4	5179-004
CD-S78E18N-2-3	5179-005
CD-S89E16N-2-3	5179-006
CD-S89E16N-3-4	5179-007
CD-S78E18N-3-4-9	5179-008
CD-S78E18N-3-4	5179-009
CD-S81E5N-2-3-9	5179-010
CD-S81E5N-3-4	5179-011
CD-S81E5N-2-3	5179-012

A complete data package was sent on June 10, 1994. At the clients request on September 18, 1995, the gamma spec analyses was re - evaluated regarding the detect Ra^{223} results. The revised data sheets are attached and comments follow.

II. Analytical Results and Methodology

The analytical results for this report are presented by analytical tests. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analyses requested include: Gamma spectroscopy by method HASL 3004.5.2.3, Isotopic Thorium and Isotopic Uranium by method U-NAS-NS-3-5-, TCLP Semivolatiles by EPA method 8270, TCLP ICAP Metals, cyanide by EPA method 9010, Flashpoint by EPA method 1010, Paint Filter Test by EPA method 9095, pH by EPA method 9045, Percent Moisture by ITAS SOP PM, Sulfide by EPA method 9030, TOX by EPA method 9020, Total Organic Carbon by EPA method 9060, and TCLP Volatiles.

III. Quality Control

The QA/QC information can be found immediately following the analytical data. This QA/QC data are used to assess the laboratory's accuracy and precision during the analytical procedure.

IV. Comments/Nonconformances

GAMMA SPECTROSCOPY

At the request of the client, a review of the gamma spectroscopy report for ^{223}Ra was performed. For the samples which had ^{223}Ra, the sample spectrums were checked for the presence of the ^{223}Ra reported, all but one sample had the report based on gamma peaks at 270.12 keV and 154.02 keV. Sample 5179-004 only identified the 270.12 keV line.

Since the client did not suspect ^{223}Ra was present, the sample spectrums were checked for the presence of ^{219}Rn (the first daughter of ^{223}Ra) which has energy lines at 401.81 keV and 271.23 keV. The presence of the daughter ^{211}Bi was also checked at energy line of 351.07. None of the samples had ^{219}Rn or ^{211}Bi present.

The sample spectrums were checked for the presence of ^{227}Th and ^{227}Ac which are the precursors for ^{223}Ra. The energy lines checked were 236.0 keV and 329.7 keV for ^{227}Th and 256.2 keV for ^{227}Ac. Neither ^{227}Th nor ^{227}Ac were present.

A search of the gamma library and the spectra indicate that ^{228}Ac (daughter of ^{228}Ra) has an energy line at 270.23 keV and 154.2 keV. Since the samples contained ^{228}Ra, the 270 keV and 154 keV peak appears to be due to ^{228}Ra, not ^{223}Ra.

Therefore, since no ^{223}Ra daughter or precursor was identified, and ^{228}Ra may have interfered with the ^{223}Ra energy lines, it is concluded that ^{223}Ra is not present and has been deleted from report.

ISOTOPIC URANIUM

Sample CD-S156E49N-2-3 (5179-001) was selected for batch QC. Both the sample and the duplicate had chemical yields less than 20% for Uranium indicating a possible matrix effect. Both sets of data are reported.

Reviewed and approved:

Diane W Mueller

Diane W. Mueller
Project Manager

IT ANALYTICAL -- ST. LOUIS
GAMMA SPECTROSCOPY

BATCH DATE: 1994-May-31 PROJECT NUMBER: 537.01 BATCH NUMBER: 38537

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-001	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT1	1994-Jun-06 09:46:57

ISOTOPE:	K-40	PB-212	RA-226	RA-228	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	1.39E+01	1.56E+00	1.24E+00	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	1.45E+00	1.40E-01	1.15E-01						
MIN DET ACT:	6.97E+00	2.01E-01	1.89E-01	1.12E+00	6.49E+00	1.86E+01	1.76E+00	5.72E+01	6.98E-01

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-001DUP	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT2	1994-Jun-06 09:46:57

ISOTOPE:	K-40	RA-226	RA-228	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	7.53E+00	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	1.36E+00							
MIN DET ACT:	3.47E+00	3.34E-01	1.62E+00	1.74E+01	8.29E+01	3.61E+00	7.23E+02	1.18E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-002	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT4	1994-Jun-06 09:46:56

ISOTOPE:	K-40	PB-212	RA-226	RA-228	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	1.20E+01	1.84E+00	1.78E+00	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	1.89E+00	1.60E-01	2.12E-01						
MIN DET ACT:	6.47E+00	1.55E-01	2.35E-01	1.14E+00	5.70E+00	1.57E+01	1.92E+00	5.51E+01	6.14E-01

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-003	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT1	1994-Jun-06 10:52:02

ISOTOPE:	MN-54	EU-155	TL-208	PB-210	PB-212	BI-212	RA-223	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	6.72E+00	1.51E+01	1.31E+02	5.30E+01	3.22E+02	2.71E+02	6.76E+01	3.93E+02	6.07E+01	4.18E+02
2 SIGMA ERROR:	4.43E-01	2.43E+00	3.92E+00	8.45E+00	1.19E+01	1.12E+01	3.27E+00	4.39E+01	1.85E+00	1.22E+01
MIN DET ACT:	8.98E-01	1.53E+00	7.93E-01	9.68E+00	1.15E+00	7.10E+00	3.57E+00	1.26E+01	1.48E+00	1.92E+00

ISOTOPE:	TH-228	TH-230	TH-234	PA-234	U-234	U-235
ACTIVITY(pCi/G):	5.43E+02	NON-DETECT	6.59E+01	5.92E+01	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	6.14E+01		6.60E+00	3.60E+01		
MIN DET ACT:	3.87E+01	1.49E+02	8.17E+00	2.15E+01	3.92E+02	4.61E+00

0000001

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-004	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT2	1994-Jun-06 10:52:01

ISOTOPE:	TL-208	PB-212	BI-212	RA-223	RA-226	RA-228	TH-228	TH-230	TH-234	U-234
ACTIVITY(pCi/G):	1.75E+01	4.85E+01	3.41E+01	1.33E+01	9.78E+00	5.39E+01	1.06E+02	NON-DETECT	3.59E+01	NON-DETECT
2 SIGMA ERROR:	7.01E-01	2.10E+00	2.82E+00	1.07E+00	5.54E-01	2.02E+00	2.13E+01		4.55E+00	
MIN DET ACT:	4.83E-01	8.17E-01	3.80E+00	2.02E+00	8.72E-01	1.15E+00	3.74E+01	2.48E+02	6.90E+00	1.85E+03

ISOTOPE:	U-235
ACTIVITY(pCi/G):	NON-DETECT
2 SIGMA ERROR:	
MIN DET ACT:	2.83E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-005	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT4	1994-Jun-06 10:52:02

ISOTOPE:	K-40	I-129	CE-139	CE-141	EU-155	TL-208	PB-212	BI-212	RA-224	RA-226
ACTIVITY(pCi/G):	1.49E+02	2.81E+02	2.73E+00	5.59E+00	4.52E+01	5.44E+02	1.25E+03	1.16E+03	1.66E+03	1.62E+02
2 SIGMA ERROR:	2.08E+01	1.19E+02	5.07E-01	1.08E+00	1.55E+01	3.07E+01	6.06E+01	8.12E+01	2.44E+02	9.18E+00
MIN DET ACT:	1.55E+01	2.38E+00	9.05E-01	1.47E+00	2.61E+00	1.66E+00	1.93E+00	1.41E+01	2.14E+01	2.65E+00

ISOTOPE:	RA-228	TH-228	TH-230	TH-234	PA-231	PA-234	U-234	U-235
ACTIVITY(pCi/G):	1.85E+03	2.04E+03	NON-DETECT	1.59E+02	5.14E+02	5.79E+02	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	1.22E+02	2.03E+02		1.99E+01	2.56E+02	1.05E+02		
MIN DET ACT:	4.47E+00	6.45E+01	2.52E+02	1.36E+01	3.81E+01	2.36E+02	6.79E+02	7.96E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-006	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT1	1994-Jun-06 12:05:50

ISOTOPE:	MN-54	EU-155	TL-208	PB-210	PB-212	BI-212	RA-223	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	1.06E+00	2.11E+00	2.01E+01	1.83E+01	5.63E+01	4.18E+01	1.17E+01	4.85E+01	1.51E+01	6.55E+01
2 SIGMA ERROR:	2.73E-01	4.09E-01	6.81E-01	3.04E+00	1.98E+00	2.41E+00	8.21E-01	9.63E+00	5.68E-01	2.29E+00
MIN DET ACT:	3.39E-01	6.44E-01	3.61E-01	4.13E+00	5.29E-01	3.06E+00	1.48E+00	5.80E+00	6.15E-01	8.66E-01

ISOTOPE:	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	8.55E+01	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	1.32E+01				
MIN DET ACT:	1.64E+01	6.56E+01	3.59E+00	1.73E+02	1.93E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-007	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT2	1994-Jun-06 12:05:50

ISOTOPE:	TL-208	PB-212	BI-212	RA-226	RA-228	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	1.96E+01	5.53E+01	4.06E+01	1.39E+01	5.96E+01	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	8.38E-01	2.42E+00	3.13E+00	6.07E-01	2.10E+00					
MIN DET ACT:	5.43E-01	8.92E-01	4.68E+00	9.29E-01	1.47E+00	5.31E+01	2.69E+02	7.20E+00	2.04E+03	3.12E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-008	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT4	1994-Jun-06 12:05:49

ISOTOPE:	K-40	I-129	EU-155	TL-208	PB-210	PB-212	BI-212	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	3.51E+01	5.78E+01	5.34E+00	1.34E+02	3.39E+01	3.52E+02	2.64E+02	4.06E+02	4.72E+01	4.43E+02
2 SIGMA ERROR:	5.97E+00	2.43E+01	4.64E+00	7.83E+00	7.94E+00	1.59E+01	2.16E+01	7.01E+01	2.74E+00	2.95E+01
MIN DET ACT:	7.79E+00	1.61E+00	1.35E+00	8.15E-01	8.40E+00	9.55E-01	6.99E+00	1.05E+01	1.32E+00	1.97E+00

ISOTOPE:	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	4.38E+02	NON-DETECT	8.03E+01	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	6.31E+01		9.75E+00		
MIN DET ACT:	3.37E+01	1.42E+02	6.97E+00	3.61E+02	4.10E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-009	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT1	1994-Jun-06 13:25:47

ISOTOPE:	MN-54	EU-155	TL-208	PB-210	PB-212	BI-212	RA-223	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	6.58E+00	1.47E+01	1.27E+02	3.06E+01	3.19E+02	2.57E+02	8.03E+01	3.64E+02	4.14E+01	4.12E+02
2 SIGMA ERROR:	5.57E-01	2.31E+00	3.82E+00	7.23E+00	1.19E+01	1.23E+01	3.84E+00	3.69E+01	1.32E+00	1.18E+01
MIN DET ACT:	6.08E-01	1.47E+00	7.98E-01	9.56E+00	1.09E+00	6.73E+00	3.40E+00	1.20E+01	1.45E+00	2.06E+00

ISOTOPE:	TH-228	TH-230	TH-234	PA-231	U-234	U-235
ACTIVITY(pCi/G):	5.28E+02	NON-DETECT	7.38E+01	5.09E+01	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	6.26E+01		6.76E+00	3.33E+01		
MIN DET ACT:	3.71E+01	1.47E+02	7.96E+00	2.15E+01	3.81E+02	4.53E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-010	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT2	1994-Jun-06 13:25:47

ISOTOPE:	K-40	EU-155	TL-208	PB-212	BI-212	RA-223	RA-226	RA-228	TH-228	TH-230
ACTIVITY(pCi/G):	4.21E+01	2.41E+01	1.68E+02	3.61E+02	2.99E+02	7.58E+01	9.26E+01	4.75E+02	7.60E+02	NON-DETECT
2 SIGMA ERROR:	7.17E+00	2.35E+00	4.13E+00	1.55E+01	1.26E+01	4.34E+00	2.72E+00	1.17E+01	7.13E+01	
MIN DET ACT:	1.21E+01	8.94E+00	1.43E+00	2.31E+00	1.14E+01	5.90E+00	2.46E+00	3.70E+00	1.07E+02	6.79E+02

ISOTOPE:	TH-234	PA-231	U-234	U-235
ACTIVITY(pCi/G):	NON-DETECT	1.35E+02	NON-DETECT	NON-DETECT
2 SIGMA ERROR:		5.28E+01		
MIN DET ACT:	1.95E+01	3.62E+01	5.22E+03	8.14E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-011	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT4	1994-Jun-06 13:25:47

ISOTOPE:	K-40	CE-141	EU-155	TL-208	PB-210	PB-212	BI-212	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	8.51E+01	3.44E+00	2.33E+01	2.88E+02	3.93E+01	7.54E+02	5.79E+02	9.64E+02	3.91E+01	9.65E+02
2 SIGMA ERROR:	4.02E+01	8.21E-01	8.41E+00	1.65E+01	9.48E+00	3.26E+01	4.81E+01	1.17E+02	2.88E+00	6.32E+01
MIN DET ACT:	1.07E+01	1.04E+00	1.91E+00	1.15E+00	1.16E+01	1.28E+00	9.75E+00	1.40E+01	1.84E+00	2.88E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
537.01	5179-012	SOLID	4.500E+01 G	1994-May-22 12:00:00	DETECT1	1994-Jun-06 14:35:55

ISOTOPE:	MN-54	EU-155	TL-208	PB-210	PB-212	BI-212	RA-223	RA-224	RA-226	RA-228
ACTIVITY(pCi/G):	1.19E+01	2.80E+01	2.30E+02	1.04E+02	5.74E+02	4.66E+02	1.23E+02	6.31E+02	1.31E+02	7.41E+02
2 SIGMA ERROR:	7.74E-01	4.08E+00	6.64E+00	1.66E+01	2.10E+01	1.86E+01	5.73E+00	8.64E+01	3.49E+00	2.12E+01
MIN DET ACT:	9.60E-01	1.98E+00	1.14E+00	1.26E+01	1.54E+00	9.13E+00	4.74E+00	1.71E+01	1.94E+00	3.09E+00

ISOTOPE:	TH-228	TH-230	TH-234	PA-231	U-234	U-235
ACTIVITY(pCi/G):	9.36E+02	NON-DETECT	1.21E+02	9.92E+01	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	7.91E+01		1.20E+01	6.68E+01		
MIN DET ACT:	5.05E+01	1.94E+02	1.07E+01	2.86E+01	5.14E+02	6.18E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
337.04	5187-001	SOLID	4.500E+01 G	1994-May-23 12:00:00	DETECT2	1994-Jun-06 14:35:55

ISOTOPE:	EU-155	TL-208	PB-212	BI-212	RA-226	RA-228	TH-228	TH-230	TH-234	U-234
ACTIVITY(pCi/G):	3.71E+00	1.92E+01	5.43E+01	3.81E+01	1.70E+01	8.34E+01	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	6.36E-01	8.35E-01	2.65E+00	3.58E+00	7.03E-01	3.12E+00				
MIN DET ACT:	1.64E+00	5.86E-01	9.70E-01	5.15E+00	1.03E+00	1.40E+00	5.19E+01	2.82E+02	7.36E+00	2.11E+03

ISOTOPE:	U-235
ACTIVITY(pCi/G):	NON-DETECT
2 SIGMA ERROR:	
MIN DET ACT:	3.14E+00

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
000.01	BLK38537	SOLID	4.500E+01 G	1994-May-31 12:00:00	DETECT4	1994-Jun-06 14:59:19

ISOTOPE:	RA-226	RA-228	TH-228	TH-230	TH-234	U-234	U-235
ACTIVITY(pCi/G):	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT
2 SIGMA ERROR:							
MIN DET ACT:	3.18E-01	6.04E-01	3.68E+00	1.13E+01	1.37E+00	3.95E+01	4.88E-01

PROJ.	SAMPLE NO.	MATRIX	SAMPLE SIZE	SAMPLE DATE/TIME	DETECTOR NO.	COUNT DATE/TIME
000.01	LCS38537	SOLID	4.500E+01 G	1994-Oct-01 12:00:00	DETECT1	1994-Jun-06 16:06:15

ISOTOPE:	CO-57	CO-60	Y-88	CD-109	SN-113	CS-137	CE-139	HG-203	RA-226	RA-228
ACTIVITY(pCi/G):	8.43E+02	1.86E+03	1.06E+03	3.31E+04	6.99E+02	1.51E+03	4.12E+02	6.78E+01	NON-DETECT	NON-DETECT
2 SIGMA ERROR:	3.27E+01	5.83E+01	4.27E+01	1.72E+03	3.56E+01	7.74E+01	2.27E+01	3.92E+00		
MIN DET ACT:	2.53E+00	6.72E+00	5.42E+00	7.24E+01	5.06E+00	6.41E+00	2.60E+00	3.28E+00	8.83E+00	2.83E+01

ISOTOPE:	TH-228	TH-230	TH-234	U-234	U-235	AM-241
ACTIVITY(pCi/G):	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	NON-DETECT	3.52E+03
2 SIGMA ERROR:						3.19E+02
MIN DET ACT:	2.70E+02	9.14E+02	4.83E+01	3.23E+03	2.23E+01	8.22E+00

0000004